ANNUAL REPORT

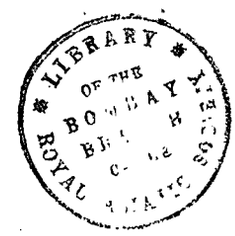
OF THE

DEPARTMENT OF AGRICULTURE,

BOMBAY PRESIDENCY,

FOR THE YEAR

1906-1907.



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No. A/5478 of 1907.

From

P. J. MEAD, Esq., B.A., I. C. S.,
Acting Director of Agriculture,
Poona;

To

The Honourable Mr. R. P. BARROW, I. C. S.,
Chief Secretary to Government,
Revenue Department, Bombay.

Poona, 5th October 1907.

Sir,

I have the honour to submit herewith the Annual Report of the Department of Agriculture for the year 1906-07 ending with the 30th of June 1907.

CHAPTER I.

Prefatory.

2. Mr. Lawrence was in charge of the Department till 21st September 1906 when he proceeded on leave. He had also charge of the duties of the Director of Land Records and the Inspector General of Registration till 24th August. I have been in charge of the Department since Mr. Lawrence went on leave. Prior to that, I was placed on special duty from 2nd August to work with him.

3. The expert European staff of the Bombay Agricultural Department has been augmented by the appointment of a Second Deputy Director of Agriculture, whose post has been sanctioned by the Secretary of State. Sanction of the Secretary of State has also been received, after the close of the year, to the following subordinate posts :—

1 Assistant Professor of Botany.
1 Assistant Professor of Agriculture.
1 Assistant Professor of Agricultural Chemistry.
1 Assistant Professor of Entomology.
1 Assistant Professor of Physics and Mathematics.
1 Assistant Professor of Mycology.
4 Divisional Inspectors of Agriculture.

Sanction of the Secretary of State has also been received to the appointment of Dr. H. H. Mann, D. Sc., as Professor of Chemistry and Principal of the Poona Agricultural College. Dr. Mann will join his appointment in November next.

4. *European Staff.*—Mr. Fletcher, Deputy Director of Agriculture, continued on leave till 30th October 1906. His duties were performed during his absence by Mr. Knight with the assistance of Mr. T. F. Main, Assistant Inspector General of Agriculture, whose services were placed at the disposal of this Department for about 6 months by the Inspector General to study the cultivation of Egyptian cotton and make some preliminary investigations into Sind conditions.

Mr. Fletcher travelled rapidly spending nearly all his time on the Stations under his charge. He further toured over the Surat and Broach districts in connection with his investigations into cotton and wheat cultivation, made all arrangements with Mr. Thompstone's assistance for the Surat Agricultural Exhibition and visited the Hagari station in the Madras Presidency at the request of that Government. In addition to his work as Deputy Director

of Agriculture Mr. Fletcher also acted as Professor of Agriculture from the 16th April and in this capacity had to administer three more stations and draw up the cropping schemes and reports from Mr. Knight's notes. In January Mr. Henderson's appointment gave some relief and Sind was only once visited. Mr. Fletcher has shown great enthusiasm and capacity for work and his departure is a great loss to the Department. His methods were thorough and scientific and his work on plant breeding has materially contributed to our knowledge. In particular he has bequeathed to us a most complete collection of cultivated cottons and his monograph on these should prove of the greatest assistance to his successor.

5. Mr. Knight, Professor of Agriculture, proceeded on leave for 6 months from 14th March 1907, handing over charge to Mr. Thompstone, Assistant Deputy Director. The latter was shortly after transferred to Burma as Principal of the Agricultural College and handed over the charge to Mr. Fletcher on the 15th April.

Mr. Knight, in addition to lecturing to the students of the College and supervising the operations of the Stations under him, gave instruction to the class of junior Civilians and to the agricultural teachers of the Training Colleges. He attended the Ahmednagar Show in the organisation of which he gave the Collector most valuable assistance. The Civil Dairy took up much of Mr. Knight's spare time, but he further volunteered to give a special course of instruction to the agricultural teachers of the Vernacular Training Colleges. Mr. Knight has displayed great energy and enthusiasm and his increasing experience of Deccan agricultural conditions is a valuable asset to the Department.

6. Mr. Gammie, Economic Botanist, besides being in charge of the Botanical Survey (transferred to this Department from the commencement of the current financial year), continued in charge of the Ganesh Khind and Bassein Botanical Gardens and lectured on Botany to the agricultural students. In June 1906 he visited the Nilgiris and Bangalore to study the methods of rubber cultivation and make enquiries about fruit culture. At the request of the Director of Agriculture, Central Provinces, he paid a visit to Nagpur in November to assist in the selection of cotton types. He was on privilege leave for 1½ months (from 21st April 1907 to 5th June), and with characteristic energy devoted much of his leave to botanical investigations. He further visited many parts of the Presidency and gave most valuable advice on several questions in connection with cotton and other crops. Mr. Gammie's great experience of Indian agriculture conjoined with his scientific attainments and common sense make him one of the most valuable of our expert advisers. His administrative abilities are also considerable and he has displayed exceptional capacity in training his staff. His readiness to co-operate with other scientific workers is no less marked. Fortunately he received considerable assistance in teaching from his Assistant, Mr. Chibber, but the time available for such valuable research work as Mr. Gammie is fully competent to carry out is still far too short.

7. The Laboratory of the Agricultural Chemist Mr. Meggitt was equipped with the apparatus and chemicals necessary for analytical work and 646 samples of soils, water, oil-seeds, manures, Ráb-materials, Gul, milk, etc., were received during the year for analysis. A Laboratory Assistant on Rs. 150—10—200 has been appointed under Mr. Meggitt from 20th November 1906. Mr. Meggitt's time was principally devoted to teaching and the absence of the Assistant Professor is very much felt. Mr. Meggitt also visited Bangalore and the Nilgiris in June 1906 to inspect the laboratory of the Agricultural Chemist to the Government of Mysore and make enquiry about the extraction of rubber. Mr. Meggitt has done an exceptionally hard year's work and should prove a most valuable acquisition to the scientific staff of Eastern Bengal and Assam on relief by Dr. Mann.

8. Mr. Thompstone was appointed to the temporary post of Assistant to the Deputy Director of Agriculture in September 1906 with a view to his being trained for the Deputy Director's post, but after a short stay he was transferred to Burma as Principal of the Agricultural College.

9. Mr. Henderson was temporarily appointed as Assistant to the Deputy Director in January 1907 and was subsequently appointed in July to the new post of Second Deputy Director. He has been given the charge of Sind where the principal work on which he was engaged was investigation of Kalar or alkali soils, and the inspection of the area under Egyptian cotton. He has submitted proposals for the establishment of a Kalar Reclamation Station on the Daulatpur Minor which are at present under consideration. Mr. Henderson is much impressed with thenecessity for and the possibilities of agricultural improvement in Sind and with a better trained staff and individual attention Sind agriculture may be expected to show considerable developments in the near future. Mr. Henderson's views that drainage must go hand in hand with the development of irrigation in Sind and that Egyptian cotton carefully cultivated is almost an assured success but carelessly cultivated is an equally certain failure may be taken as an indication of the principal lines of work in that province for some years to come.

10. *Native Staff.*—Mr. Kelkar in addition to lecturing to the students of the agricultural classes inspected the crops of the Pondicherry variety of groundnut distributed during the preceding year, supervised further distribution in the year under report, made enquiries along the Nira Canal tract regarding the use of safflower cake as manure for sugarcane, and attended the Shows at Pandharpur, Mhaswad, Sholápur, Surat and Ahmednagar. Mr. Kelkar was on privilege leave for one month in April-May: Mr. Kelkar has practically had to double up two posts, working both as Inspector and Assistant Professor of Agriculture. The assistance he has been able to give to the Professor of Agriculture has been considerable, but it may be hoped that separate appointments will soon be possible. Any undue multiplication of duties is fatal to scientific work.

11. Mr. Mahli, Divisional Inspector of Agriculture in Sind, continued in charge of the Mirpurkhás Station till near the close of the year when Mr. Gul Mahomad, fieldman, was put in charge. Owing to great difficulty of obtaining labourers in Sind for the Mirpurkhás Station Mr. Mahli was deputed to the Punjáb to make enquiry regarding the advisability of importing labourers from that province but the high wages demanded prevented the adoption of this course.

12. Messrs. Bhándárkar and Chibber continued to hold the posts of Assistant Professor of Mathematics and Physics and Assistant Professor of Botany, respectively, during the year under report. Mr. Bhándárkar has since been transferred to the Public Works Department and his post has been filled by the appointment of Mr. H. K. Mehta, B A.,B.Sc. Mr. Chhibber has worked well under Mr. Gammie and gives every promise of being a most successful recruit.

13. Messrs. G. D. Mehta and V. H. Gonehalli, who were sent to Cambridge during the last 2 years, are, it is learnt, specialising in (1) Chemistry and Mycology and (2) Zoology and Entomology respectively. They will, on their return, be eligible for appointment to the posts of Assistant Professors of Mycology and Entomology sanctioned by the Secretary of State as noted in paragraph 3 above. Their permanent relegation to work on the College staff is however a matter for further consideration. A full time Entomologist and Mycologist are undoubtedly required for the Department and as work increases there is little doubt that it will be found necessary to give these officers adequate relief from their duties as lecturers and thus set them free for research work. The question of arranging for Entomological and Mycological work in the various Provincial Departments will be taken up probably at the next Agricultural Conference. In addition to the above Mr. P. J. Bhatt, L.Ag., B.Sc., who secured the Sir Mangaldás Nathubhái's scholarship of the value of Rs. 1,820 per annum and was holding the temporary appointment of Lecturer in Chemistry at the agricultural classes, was also granted a Government scholarship of £ 100 per annum and was deputed in August 1907 to Cambridge to specialise in Agricultural Chemistry. He will on finishing his course be appointed to the post of Assistant Professor of Chemistry.

14. Of the 10 successful candidates belonging to this Presidency who obtained the Degree of Agriculture in December 1906, seven have been employed either as fieldmen or clerks. One did not apply for service, one has secured service in the United Provinces and one has gone to England to specialise in Agricultural Chemistry.

15. Government have sanctioned proposals submitted by this office for the material improvement of the prospects of the subordinate establishment.

16. Mr. Lawrence visited 5 districts and I visited 16.

17. The third meeting of the Imperial Board of Agriculture was held at Cawnpore from 17th to 23rd February 1907 and was attended by all the officers of the Department except Mr. Henderson who was engaged in the preliminary investigation into the alkali problem in Sind.

18. The chief subjects dealt with during the year were as noted below:—

(1) Distribution of foreign groundnut seed in the Deccan and cotton seed in Gujarát and Sind.

(2) Cultivation of flax in the Bombay Presidency.

(3) Question regarding provision of an expert staff to draw up reports and maps in connection with additional small works of irrigation (G. R. No. 5156, dated 26th May 1906, R. D.).

(4) Instructions of the Government of India on certain recommendations made by the Irrigation Commission (G. R. No. 11286 of 29th November 1906, R. D.)

(5) Free grants for improvements of lands. (G. R. No. 4331, dated 2nd May 1906, R. D.)

(6) Reports on the expansion of the Agricultural Department.

(7) Suggestions regarding the working of the Agricultural Stations.

(8) Reports regarding decline in the cultivation of groundnut.

(9) Proposals regarding separation of the office of the Director of Agriculture and the Director of Land Records.

(10) Report regarding the fumigation of imported cotton seed.

(11) Proposals regarding the preparation of sugarcane forecasts and revision of the forecast form.

(12) Discussion in committee of all permanent cropping schemes on experimental stations.

(13) Various special statistical returns and reports on suggestions for the amendment of others.

CHAPTER II.

Agricultural Stations and Special Inquiries.

19. During the year the stations in charge of the Department were as under:—

1. Surat, Gujarát (General experiments principally cotton and jowár).
2. Nadiád, Kaira, Gujarát (General experiments, principally millets and tobacco).
3. Dohad, Panch Maháls, Gujarát (Cotton, rice and other crops under irrigation).
4. Dhárwár, Karnátak (General experiments principally cotton and millets).
5. Dhulia, West Khándesh, Deccan (General experiments principally cotton and jowár).
6. Kirkee, Poona, Deccan (Mycological experiments and dairy farm).
7. Lánowli, Poona, Deccan (Experiments with ráb and other manures for rice).
8. Agricultural College, Poona, Deccan (Object lessons and students' plots).
9. Mánjri, Poona, Deccan (General experiments, principally sugarcane).
10. Bárámati, Poona, Deccan (Demonstration Station for sugarcane and irrigated cotton).
11. Ganesh Khind, Poona, Deccan (Botanical research).
12. Bassein, Thána, Konkan (Botanical research and garden crops).
13. Mirpurkhás, Thar and Párkar, Sind, (Cotton, berseem, etc., under irrigation and reclamation of land).

20. At Surat the old area (acres 66) which had hitherto been rented for the Station was purchased at a cost of Rs. 16,274 and an additional area of 23 acres bordering on the Station was acquired at a cost of Rs. 3,864 to make the Station a compact block. The awards made in both the cases have been disputed and are under reference to the civil Court.

21. Work on the Dohad Station was intended to be started in the rabi season but there were no cultural operations during the year owing to the late ripening of the crops already sown by the original occupants and partly owing to dearth of labour. Work has commenced in the current season.

22. The Dhárwár Station has been extended by renting an additional area of 60 acres. The new area is admirably fitted for experimental plots and has been carefully laid out with a permanent cropping scheme. The old area was mostly uneven in character and will be reserved for cotton breeding and selection.

23. A part of the area acquired for the Agricultural College has been set apart for students and object lesson plots for practical instruction to the Agricultural and Training College students. Hitherto these plots were on the Poona Station. During the year under report a part of the area was devoted to the growth of fodder crops for the Dairy. From this year a larger area will be worked for educational purposes. It is under contemplation to reserve a suitable portion for experiments in cultivation without the assistance of irrigation.

24. Inquiry has shown that the system of dry farming practised in America and referred to in paragraph 2 of Government Resolution No. 0693 of November 1st is not likely to revolutionise methods of cultivation in the Deccan. In fact no fresh light is thrown on the old problem of conservation of moisture by thorough tillage and beyond the possible utility of a new agricultural implement called the 'subsoil packer' little is to be learnt from the literature on the subject. The American Bureau of Agriculture explicitly discounts the chorus of praises with which this picturesque re-statement of old principles has been hailed as a new panacea for all dry land. That however is no reason why this Department should not investigate the problems affecting so large a proportion of the agricultural population in India, and as the Poona Station is not suited for general experimental work and Mánjri is devoted to irrigation it will be useful to carry out preliminary investigations on the large area available on the College Station.

25. Land has been secured near Bárámati under command of the Nira Canal to demonstrate the results obtained at Mánjri from sugarcane experiments. A part of the area is also devoted to the raising of Broach cotton under irrigation.

26. Land has been acquired during the year for an irrigational Station under the Gokák Canal. Sixty-five acres have been purchased at a cost of Rs. 6,236. It has not, however, been found possible to start operations this year owing to paucity of trained hands. This difficulty will, it is hoped, soon be removed. The area has, during the current season, been leased out for cultivation.

27. Proposals for starting a reclamation Station in Sind have been sanctioned. For this purpose about 400 acres of land has been selected at Daulatpur and reserved for the Department.

28. The additional buildings on the Surat station are in course of construction. A second well has been built on the Dhárwár station for the irrigation of cotton hybrids. Buildings have been erected for the Dohad and College Stations. A tobacco curing house has been erected on the Nadiád Station. Quarters for the Superintendent are in course of construction at Ganeshkhind and the dilapidated buildings at Bassein have all been thoroughly repaired at a cost of Rs. 5,200.

29. Machinery for crushing sugarcane with the aid of an oil engine has been installed at Mánjri at a cost of about Rs. 7,000 of which Rs. 5,000 have been contributed by the Inspector General of Agriculture.

30. *Irrigation.*—In accordance with the recommendations made by the Indian Irrigation Commission the work of investigating projects for the construction of great Lake Reservoirs in the Western Ghats is being pushed on.

The plans and estimates for the Godávari Canal project (estimated to cost 96 lákhs) have received the assent of the Secretary of State and work has commenced. Plans and estimates for the Gokák Canal Extension Project (179 lakhs) and Pravára River Irrigation Project (86 lákhs) have been submitted to the Government of India. The Nira Right Bank Canal Project is being worked up. The above schemes have all storage works in the Ghát region where the rainfall is assured but there are other smaller works which are not so fabourably situated and in whose case the catchment areas lie within the precarions tracts of the Deccan. With a view to examine these cases Government have directed the examination of a few typical cases for consideration and proposals for four tanks—Shirsuphal and Bhádalvádi in the Poona District and Maini and Yerla works in the Sátára District have been prepared by the local Engineers and are under consideration.

31. The Director was appointed a member of the Committee for the revision of rules in connection with the working of the Block system and the recommendations of the Committee have generally been approved by Government and their practical working will be examined on one of the distributaries of the Nira Canal.

32. The usual detailed account of experiments on existing Stations is separately published but has this year been issued in separate reports for each Station. In place of last year's summary of this work the experimenters have this year been asked to tell their own tale and it is hoped that these more popular and less detailed accounts which are attached to this report will prove of general interest.

Much of the work done on any experimental station can be of very little interest to the public for years to come. No valuable opinion can be expressed or conclusions drawn till the experience of years has corroborated the opinions tentatively formed from tendencies observed each year. A plea for patient criticism of the Department's experimental work is therefore entirely justifiable. So far as possible, however, the public will always be taken into the Department's confidence and the fullest criticism is of course invited on such work as has reached a stage at which publication is possible. But on the larger question such as plant breeding and seed selection judgment must be suspended till results, whether negative or positive, have been demonstrated.

33. *Egyptian Cotton.*—Fifty tons of fresh Egyptian cotton seed were ordered out early in 1906 and distributed in Thar and Párkar, mainly in the Mirpurkhás and Jamesabad Tálukas. The total area occupied by the crops was about 5,100 acres. The seed was sown at 20 lbs. per rupee. The total cost of the operations came to Rs. 6,200 and the sale-proceeds (both realised and still to be realised) came to Rs. 5,600. The season was not satisfactory. The crop was affected by boll worm everywhere, which reduced the outturn considerably. In Mr. Fletcher's opinion this was principally due to overwatering and too thick sowing, the resulting moist atmosphere between plants being eminently adapted to the propagation of the worm. The question was however discussed at Cawnpore and we decided to follow the Punjáb example and enlist Mr. Lefroy's aid to keep the boll worm in check by the introduction of its principal parasite (Rhogus Lefroyi). This is being tried in the current year.

34. The success of the system of public auctions for the disposal of Egyptian cotton crop has already been fully reported to Government and the public. In brief about 4,879 maunds of cotton were collected by Government agency and sold at rates varying between Rs. 10-8-0 and Rs. 14 per maund, the average being Rs. 11-15-0. These prices were considerably higher than those obtained in the previous year. The cost of the operations came to Rs. 3,229. Government have directed that the same arrangement should be made the next year but that the whole cost of the operations should be recovered from the Zamindárs. This system of public auctions with a view to obtain fair prices for cultivators for a new crop was generally approved at the last Agricultural Conference. For next year's crop fresh Mitaffifi seed has been mainly distributed. All the 4 varieties are still to be tried at the Station and the question of deterioration under Sind conditions is to be carefully examined.

35. *Broach Cotton.*—Trials with Broach cotton grown under irrigation having proved remarkably satisfactory at the Mánjri Station, seed was distributed to a number of cultivators in 15 tálukas of the Deccan for trial on lands commanded by irrigation canals. Detailed instructions were drawn up and circulated for the guidance of the cultivators and an itinerating officer of this Department was specially appointed to supervise operations. The result, however, was not successful. In all 118 acres were sown with this crop over 107 fields. An inspection at the later stage showed that instructions of this Department had not been attended to over 32·2 per cent., the crop was a complete failure over 22·5 per cent., it gave a partial yield over 39·1 per cent., and was successful only over 4·2 per cent. of the total area. The specimens of the cottons received were examined by Mr. Fletcher, who considered them 3 to 12 per cent. below good Broach. To save disappointment it is proposed to give compensation to those whose crops fail apparently through no fault of theirs. This attempt to supervise experiments over widely scattered areas having proved practically impossible, it has been decided to restrict experiments for the present to an area in the vicinity of the Bárámati demonstration station.

36. The small quantity of Broach seed distributed in the Dhárwár District was extremely popular for the reasons given by Mr. Fletcher. It will probably be necessary to import fresh seed every 3 years or so, but this too is being tested.

37. *Improvement by selection of seed.*—About 20,860 lbs. of Lálio seed were distributed in Ahmedabad in the current season at a cost of about Rs. 4,000, most of which is recoverable.

38. These operations are only intended to demonstrate to the cultivators the advantages of such selection as they are themselves competent to make, and it is doubtful whether they should be continued. The cultivators have seen for themselves the practical result of care in selection and if the practice does not spread it may safely be assumed that the cultivator does not consider it worth his while to take the trouble. The resulting improvement is not likely to be very striking and probably only a few of the best cultivators will profit by the lesson.

39. The possibility of improving cotton by plant to plant selection or otherwise is still being investigated with considerable promise of success, but this must not be confused with the distribution of a pure selected variety which is distinct enough in the field to allow of selection by any untrained observer.

40. *Egyptian clover.*—No fresh seed was imported during the year but the seed obtained from the crop sown last year was gathered and sown. The result of the first two years' trial having clearly demonstrated the value of the fodder crop 80 maunds of fresh Miscovi seed from the northern districts of Egypt have been ordered on behalf of the Colonization Officer for distribution among Zamindárs in the coming season, in addition to the quantity (6,500 lbs.) required by this Department.

41. *Jute.*—The first year's trial proved partially successful. At Ganeshkhind one plot yielded at the rate of 603 lbs. of the fibre per acre; the second plot was comparatively poor as was the case also at the Poona Station. At Mirpurkhás it was a failure. At Dhárwár it has also done no good. The fibre was valued by a Calcutta firm at Rs. 10-4. A second trial is being made this season and the crop at Ganeshkhind is considered very promising by Mr. Finlow. Much of the seed supplied this year was bad however and Mr. Finlow has promised to secure us specially selected seed for next year's experiments.

42. *Groundnut.*—The distribution of foreign varieties which ripen early is still being continued. Last year 3 tons of the Pondicherry variety were distributed to selected cultivators in 2 tálukas of Sátára, 2 of Násik and one of Poona. Inspection made by the Divisional Inspector at the end of the season showed that the imported variety yielded much better than the local and the cultivators were generally eager to buy the foreign seed in spite of the following drawbacks attributed to it:—

(1) The nuts are apt to be damaged by rains following after the crop matures and inducing a sour taste in the seed. Thus the varieties are suitable only in tracts of light rainfall.

(2) The nuts are more oily and are less palatable for raw eating than the local variety.

(3) The pods are formed nearer the surface than in the indigenous variety and thus are more liable to the ravages of birds, pigs, jackals, etc.

(4) The foliage dries up and falls off as the crop matures and thus the bye-product is not so useful as cattle food as it is in the case of the indigenous variety.

(5) The crop ripens when rabi sowings are in full swing and it is somewhat difficult at this time to secure the large number of labourers required for harvesting this crop.

The distribution cost about Rs. 600, of which Rs. 321 were received from the cultivators as price of the seed.

43. To meet the large demand created by the results obtained in the last season 5 tons of each of the Spanish, Japanese and Pondicherry varieties of groundnuts have been obtained and distributed in the current season at a cost of Rs. 4,800. It will probably be necessary to consider whether steps should not be taken to assist the cultivators of exotic varieties to obtain a fair price for their produce.

44. In Sind the crop has not found favour: but further trials will be made if suitable soils can be found. About 300 lbs. of groundnut were distributed in 2 tálukas (Jamesabad and Mirpurkhás) of Thar and Párkar in Sind in March 1906. The crop did not grow well and the result is attributed by the Deputy Director of Agriculture to careless cultivation. He states that where the slightest care was taken the crop yielded fairly well.

45. *Wheat Survey.*—At the Pusa Conference of 1906, the question of the improvement of wheat was considered and it was recommended that as a preliminary step in this direction an agricultural survey of the varieties of wheat grown in different provinces should be taken up and completed in all provinces. The Government of India having approved the recommendation and directed the survey the necessary information is being collected through the agency of the District Agricultural Inspectors to whom detailed instructions have been issued in the matter and the information when received will be collated by the Deputy Director of Agriculture. Meanwhile Mr. Gammie's experiments in wheat breeding are proceeding and judging from the successes claimed in England a considerable measure of improvement may be anticipated. The problem at any rate is far simpler with wheats than with cottons where success depends to a great extent on fixing a very subordinate character, the mere appendage of the seed, by breeding between different species.

CHAPTER III.

Entomology and Mycology.

46. Locusts gave little trouble. I am afraid Mr. Lawrence's fears have been realised and the South African fungus remedy has been definitely declared a myth so far as India is concerned. An attempt is being made to collect and put on record any information about the seasons in their relations to the successful or unsuccessful propagation of locusts but little can be done without an increase to our Entomological staff. The whole question of provincial work in Entomology and Mycology will be considered at the next Agricultural Conference.

47. Mr. Lefroy, the Imperial Entomologist brought to notice the appearance of the potato moth (Phthorimaca operculella) in the Belgaum and Dhárwár Districts and recommended the investigation of this pest. His first view was that this pest had not hitherto been found in India but had probably been recently introduced from Europe. Mr. Dixon, Entomological Assistant, was entrusted with this enquiry and toured rapidly over the principal potato growing tracts while Mr. Kásárgode was deputed to examine the state of affairs in Belgaum itself. It was ascertained that the pest has been known in these parts for 12 years or more and like other pests varies with the season.

Mr. Fletcher has formed the tentative opinion that proper earthing up is a preventive and that possibly effective storage in moth-proof store houses would effect considerable improvement. The whole question merits close study and Mr. Lefroy's assistance, which is always readily given, will again be invoked.

48. *The American cotton boll weevil.*—Fumigating chambers have been erected at Bombay and Karáchi for the fumigation of cotton seed imported from America and the West Indies. The fumigating agent selected, *viz.*, bi-sulphate of carbon, is reported to be effective in destroying weevil eggs and at the same time innocuous to the germinating power of the seed treated.

With a view to take precautionary measures against the possible introduction of this pest from the Portuguese territories in India, the Portuguese authorities at Goa were informed of the measures adopted by this Government in the matter and the advisability of taking similar measures, if not already adopted, was brought to their notice for consideration. It appears however on enquiry that the Portuguese authorities are fully alive to the serious danger in the event of the pest being once introduced into the country and that they have already taken the requisite steps in this direction.

49. In December 1906, the Chamber of Commerce, Bombay, recommended to the Local Government that precautionary measures should be taken in respect of the importation of plants from foreign countries in the same way as the measures recently adopted in connection with the cotton seed imported from America. The question was informally discussed at Cawnpur with the Inspector-General of Agriculture and the Imperial Entomologist. It is agreed that there is undoubtedly considerable danger of foreign pests being introduced into this country through the medium of plants imported from foreign country and the appearance of the potato moth (Phthorimaca operculella) may be taken as a case in point. In some countries (*e. g.*, Australia, West Indies and Natal) legislation has already been undertaken to avert the danger. The question is however one which deserves the most careful deliberation and it is at present under the consideration of Government. The precise form which the notifications should assume and detailed information as regards the bulk and nature of consignments of plants and vegetable products are the chief factors of difficulty in the settlement of this important problem.

50. Our boll-worm experiences in Sind have already been noted above.

51. The grass-hoppers at Belgaum continued to do some local damage. Rs. 150 were placed at the disposal of the Collector of Belgaum for their destruction and almost the whole of this amount was expended. Their life history, which has now been observed, is embodied in Bulletin No. 27 published by this Department.

52. *Mycology.*—At the Poona Station the experiments in Tika disease of groundnut and wilt disease of Tur were continued but as shown in Mr. Fletcher's report definite results have not been obtained and it will be considered in consultation with Dr. Butler whether these experiments should be further continued on their present site.

CHAPTER IV.

Agricultural Education.

53. As last year the teaching of the students of the agricultural course was conducted in the 2 bungalows hired for the purpose.

54. The present teaching staff consists of the Professors of (*a*) Agriculture, (*b*) Economic Botany, and (*c*) Agricultural Chemistry and the Assistant Professors of (*a*) Botany, (*b*) Mathematics and Physics. The Professor of Agriculture is assisted by Mr. Kelkar, Inspector of Farms, and Mr. Pátil, who is in charge of the College Farm, and gives practical instruction to the students. Mr. Sánga is the lecturer on Veterinary subjects while Mr. Sethna, who is in charge of the Veterinary Dispensary at Bámbhurda, gives practical instruction in veterinary matters to the students. Dr. Mann's appointment has already been mentioned.

55. In 1902-03, there were only 27 students studying agriculture whereas last year (1905-06), there were 113 students on the College rolls. On the 30th June last there were 95 students on the rolls. Of these 31 are in the F. Ag., 38 in the S. Ag. and 26 are studying for the L. Ag. Examination.

56. Plans and estimates, the latter amounting to Rs. 3,47,000, of the main building in connection with the new Agricultural College have now been sanctioned by the Public Works Department; those for the Chemical Laboratory building (estimates amounting to Rs. 1,23,000) have also been sanctioned. The work of construction is in progress and Rs. 1,50,000 have been provided for the purpose in the current year's budget (1907-08).

57. The main roads leading to the College building have been constructed. The ground floor of the laboratory building has been completed and the second floor is under construction. The main College building is progressing slowly.

58. The buildings in connection with the demonstration Station attached to the Agricultural College have been referred to above.

59. A revised curriculum for the agricultural course based on the one discussed at the Agricultural Conference held at Pusa in January 1906, has already been submitted to the University and has, it is understood, been approved.

60. An application has also been submitted to the University for the affiliation of the new Agricultural College to the University of Bombay and sanction has been accorded. It is proposed to institute a new degree of B. Ag. and to abolish the present degree of Licentiate of Agriculture.

61. The number of scholarships in the agricultural course has been increased. In November 1906, Government sanctioned the grant for each class of 8 scholarships for the Presidency proper and 4 for Sind.

62. A course for Junior Civilians for instruction in elementary knowledge of agriculture was held as usual under the direction of Mr. J. B. Knight at Poona from the 8th to the 27th October. The written examination was held on the last day and the Civilians attending the course were all given the usual certificate.

63. Reference has already been made to the special course of instruction given by Mr. Knight to the agricultural teachers attached to the Vernacular Training Colleges at Ahmadabad, Poona, Dhárwár and Hyderabad.

CHAPTER V.

Publication of Agricultural Information.

64. The annual Season and Crop Report has been separately published containing the agricultural statistics of the Presidency. The preliminary and final forecasts on wheat, cotton, sesamum, groundnut, linseed and rapeseed have been issued from time to time.

65. At the suggestion of the Director-General of Commercial Intelligence proposals regarding the issue of a forecast on sugarcane crop have been submitted to Government and have been sanctioned.

66. A suggestion was received from the Chamber of Commerce, Karáchi, for the issue of separate forecasts for the province of Sind. The matter is under consideration by the Commissioner in Sind.

67. In March last, the Government of India issued certain instructions for the improvement of the wheat forecast. Particular attention has been called to the necessity of checking the estimate of outturn reported by the local officers. A plan has been devised for the purpose as also for checking the estimates of outturn of cotton and circulated for the opinion of District Officers.

68. Mr. Fletcher's important bulletin on Cotton which was referred to in the last year's report was issued during the year. A more comprehensive bulletin with copious illustrations on the Cultivated Cottons of the World has already been noted and is under preparation, by the same officer. Mr. Fletcher has also issued instructions for the sowing and after cultivation of Egyptian cotton without ridging and prepared a leaflet on smut.

69. A note on Mr. Spence's cotton (Bourbon) was prepared by the Director and distributed to the District Officers.

70. The bulletin on the edible Date palm prepared by Mr. Fletcher was issued both by the Reporter on Economic Products to the Government of India and this Department.

71. A bulletin on the Cattle of the Bombay Presidency by Major F. Joslen, prepared when Superintendent of the Civil Veterinary Department, was issued. This bulletin describes the cattle of Gujarát and is the first instalment of a series which will cover all the principal breeds of the Presidency proper.

72. A bulletin on Rice Grass-hoppers prepared by Messrs. Knight and Dixon was issued.

73. An offer was made by the Baroda State to translate Mr. Lefroy's work on Insect pests into Gujaráti; but Mr. Lefroy suggested that the book in its present form was not suitable for translation and has offered to prepare an edition for translation and arrange for a Gujaráti translation, provided the Baroda State bore half the cost of publication. Government have agreed to contribute the remaining moiety but nothing further has been heard from the Baroda State on the subject.

74. Government sanction has been applied for to enter into an arrangement with the editors of the Khedut and the Shetkari, the Gujaráti and Maráthi agricultural magazines for the publications in the vernaculars of bulletins, leaflets and other contributions from the Agricultural Department with illustrations to be supplied by Government where such a course is necessary to make the letter press intelligible. The use of simple plates to attract readers and in particular to arouse interest in the study of insect pests is an experiment which may meet with some success. The better educated cultivators already read with avidity such articles on agriculture as come to their notice and if only their interest is aroused we may hope for still more numerous enquiries and requests for assistance. There is no agricultural magazine in Kánarese but for the present the Karnátak Vritta, a weekly paper, has been selected.

If the proposal is sanctioned by Government a beginning will be made by publishing a Gujaráti and Maráthi translation of a brief illustrated account of Indian locusts contributed by Mr. Lefroy to the Agricultural Journal of India.

75. Visits by cultivators to the various agricultural Stations show an increase on last year's figures. The Superintendents have also established relations with the neighbouring cultivators with varying degrees of success. Something can be done, pending the appointment of an adequate itinerating staff to give advice and practical demonstrations on many of our stations and in 62 cases experiments have also been carried out by our Superintendents on private lands. This is perhaps the most satisfactory of all methods of demonstration but close superintendence is essential and the numbers of our trained and reliable men are still regrettably small. There is no more important duty at the present stage than that of carefully training on our stations the material we receive. The passed agricultural graduate considers himself competent to supervise any experimental operations or give advice to any untrained cultivator. He is of course only on the threshold of his career of usefulness. Until he learns the value of accuracy his observations are worthless and in practical agricultural knowledge he has more to learn than he can teach the ordinary rayat. Further, as might be naturally expected, many of our graduates prove on testing to be deficient in natural aptitude for the work and such must be replaced. The process of collection of an adequate staff is therefore necessarily slow and before we can provide lecturers in any number many years must elapse.

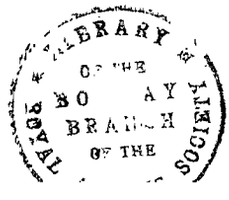
76. This year also good work was done by Mr. Kelkar and the first appointments to make as soon as our material permits will be those of full time

Agricultural Inspectors. The second step will perhaps be the institution on certain of our stations of vernacular classes to teach and demonstrate specific points in agricultural practice to selected cultivators in tracts where the local practice is glaringly defective. Already inquiries have been made from one district as regards the possibility of obtaining instruction on any of our stations in the proper methods of selection of seed and where such instructions can usefully be given it will be done. But it is clear that the first essential is a careful investigation of the present agricultural practice in the various tracts by competent observers and till these are available progress must be slow. A general opinion on the deficiencies of present agricultural practice is not very helpful. Specific instances or omissions must be noted and a specific and patently adequate remedy applied if any impression is to be made on local practices. Mr. Kelkar's inquiries in the Nira Canal tract have disclosed the general acceptance in many villages of the Department's advice in the use of safflower cake as a manure for sugarcane. The difficulty of obtaining this manure in sufficient quantities is however very real and the cultivator has also in many cases to take the manure his Sávkar provides and be thankful.

77. Two interesting Exhibitions were held during the year at Nagar and Surat. These will form the subject of special reports but some points may be noted here. The Nagar Show was a small one but developed with great energy by the district officers who organised inter-táluka competitions in various crops. The most important feature was the number of actual cultivators who attended the show from all parts of the district, listened to the lectures with great interest and were not slow to ask various detailed questions about all they saw and heard. At Surat a most instructive set of exhibits was prepared by Mr. Fletcher, and selected cultivators from the adjoining districts were given the fullest explanations both oral and written of all the exhibits and presented with catalogues in the vernacular to remind them of what they had seen. The Nagar Show has given birth to a new Agricultural Association, but as usual, as soon as agricultural interest takes a corporate form and rules and a constitution take shape, the real cultivator recedes into the back ground and the educated classes come to the fore. Still the Collector, Mr. Orr, is confident that the Sangamner Association is genuinely interested in agricultural matters and efforts will be made to give them such assistance as is possible. Experience will show how the association develops. A more genuine growth is perhaps the Association formed *suo motu* by the cultivators in the Bárámati tract of the Poona District. Their main object is collective criticism of irrigational rates and policy but these questions naturally involve agricultural problems and we have received some useful criticism and information from this body Similar associations have sprung up *suo motu* elsewhere and the most recent of these which is apparently a representative association of the Anávla Bráhmins of Jalálpor táluka of the Surat district has applied to this Department for assistance and general information which we shall be very glad to offer. If an association of the kind is honestly interested in all questions affecting the prosperity of its agricultural members, there is no reason why it should not prove receptive to advice even though its main object is to obtain reductions of Government due or increased facilities at the hands of the Forest Department. At any rate such associations as spring up from below are likely to have a more vigorous existence than those which are fostered from above by official blandishments.

I have the honour to be,
Sir,
Your most obedient Servant,

P. J MEAD,
Acting Director of Agriculture.



APPENDIX A.

SUMMARY OF EXPERIMENTAL WORK AT THE AGRICULTURAL AND BOTANICAL STATIONS IN THE BOMBAY PRESIDENCY DURING 1906-07.

(A) Stations under the Deputy Director of Agriculture.

The work of the year has been a continuation of that of the previous year.

2. The agricultural stations in my charge and to which experimental work was largely confined were as follows:—

Name of Station.	Height above sea level.	Date of establishment of Station.	Area of Station.	Kind of soil.	Rainfall.	
					Average.	1906-07.
Surat	About sea level ...	1897	84 acres arable and 150 acres pasture.	Káli, black cotton soil (clay).	38·42	30·17
Nadiád (Kaira) ...	Do. ...	1903	44½ acres ...	Gorádu (sandy) ...	34·64	30·67
Dhárwár	2,580	1904	74 acres ...	(*a*) Black clay ... (*b*) Red sandy.	31·67	34·44
Dhulia (West Khándesh).	844	1905	28½ acres ...	Medium black ...	22·40	23·31
Mowdi (Panch Mahálsi)	.....	1906	57⅓ acres ...	Black soil (light in colour).	29·88	32·79

3. The season on all was good compared with those of the past few years so that comparatively reliable results were obtained on such plots as had been laid down for some time under a definite treatment. The details are given in the Station Reports which have been separately published for each Station—a general sketch only of the work done being given here. This is conveniently placed under the following sub-heads which in all cases, except where specially noted, are continuations of previous work:—

I.—Cotton.—(*a*) Breeding of new varieties.
(*b*) Distribution of selected seed.
(*c*) Investigation of the complex mixture of varieties grown in Khándesh.

II.—Tobacco.—Breeding and manuring.

III.—Potatoes.—Varietal trials.

IV.—Food-grains and oil-seeds.—Breeding and manuring.

V.—Groundnut.—Variety tests and distribution.

VI.—Sugarcane.—Manurial experiments.

VII.—Investigation of the role played by manures and rotations in increasing crop yields.

VIII.—Training of subordinates.

IX.—Agricultural Exhibitions.

I.—Cotton.

4. Work on this subject has been conducted at all Stations except Dohad where no experimental work has yet been commenced.

(a) Cotton breeding.

Practical results have now been obtained in the production of an improved variety for the Surtee Broach tract; the three crosses numbered 1027-A, 1338 and 1339 have maintained their superiority over the local kind for the past three seasons and showed now no variation. They have been produced respectively by crossing Kumpta with Goghári, Broach with Broach and Kumpta with Kumpta.

It should here be noted that 1027-A is not so white as the ordinary variety but this is no defect in itself though it may create some prejudice against it at first in the mind of dealers owing to the fact that Indian cottons are as a rule quite white. In spite of its colour Messrs. Ralli Brothers value it at 5 per cent. above Navsári cotton which itself carries a value of 6 or 7 per cent. above that of the best cotton we can grow at our Station. In other words the cross in question is superior to the ordinary variety *when grown under the same conditions by about 12 per cent.*

Since the same variety is grown over the whole of the Surtee Broach tract and the improvement in quality as we proceed south from Broach itself to Navsári (south of Surat) is due only to conditions of soil and climate, this cross can be grown with perfect safety over the whole of the tract. It is therefore only a matter of time and the raising of the necessary amount of seed, for a 10 to 12 per cent. improvement to be produced in the quality of cotton from the Surtee Broach tract as a whole.

When the cross has thus extended the increased value of the cotton crop from this area will not be less than 40 lákhs of rupees per annum.

Further it may be stated without risk of error that the improvement already produced is by no means the end of things and I am convinced that almost the whole of the Surtee Broach tract should produce in good seasons cotton superior to Middling American.

The crosses 1,338 and 1,339 though lacking the staple of 1027-A surpass it in colour being quite white. With proper treatment these two crosses also should improve considerably.

In addition to these crosses the produce of a single plant from the ordinary crop grown at the Surat Station that I selected three seasons ago yields cotton valued at some 4 per cent. above the ordinary crop.

It may be mentioned in passing that the cotton produced at the Surat Station is not of so high a quality as that produced in the neighbourhood. As however all the samples examined had been grown within a few yards of one another they are strictly comparable. Messrs. Ralli Brothers valued the cross 1027-A at Rs. 12 per candy (say 4½ per cent.) above the best Navsári, *i. e.*, above the best cotton grown in a restricted area that has deservedly the very highest reputation in the whole Surtee Broach tract for staple and this although the local variety grown alongside the cross was judged to be of the same quality as that grown in the worst portion of the whole tract. If this cross were grown at Navsári it follows from the facts given above that the produce would be at least 12 per cent. better than Navsári cotton, already greatly superior to that of the Surtee Broach tract as a whole.

Though not actually yet forming part of the breeding operations at the Surat Station, an extremely promising variety which I have introduced from Cambodia may be mentioned here. It is interesting to note that this variety, which is a native of Indo-China, is identical botanically with the Upland* cotton of America and is undoubtedly the original source of that crop having been introduced there in 1758. The point of practical importance from our point of view is, however, not its botanical nature but the fact that while giving a produce very similar to Middling American in its general style, and classed in Liverpool as "Fully Middling" it will grow well on the black cotton soil of the Surtee Broach plain and this the introduced American will not do. I consider that this variety under proper treatment will form an extremely valuable asset in the experiments of the Department. It appears to be subject to none of the weaknesses and delicacy of its highly-bred descendant, the American plant, which, having been raised for a special set of conditions in America is unsuited to conditions in most other portions of the globe. There is no apparent reason why the breeding of this variety for the special conditions obtaining in parts of India should not lead to an improvement comparable with that which has resulted from the introduction of this same variety into America.

This variety is the only one that can at all compare in vigour of growth and general robustness on the Surat black cotton soil with the local variety out of all the very many varieties tried, it might even be said, out of all the varieties in existence, since I have grown at Surat a collection of the cottons of the World which is probably complete. This collection primarily made for the purposes of a monograph on the subject, now in the press, has proved of great practical value. For, in addition to the above-mentioned variety from Cambodia, certain Persian cottons appear to be very suitable for crossing with Broach and other varieties of this Presidency.

With regard to the crosses at Dhárwár it can only be said that the Station is too new to have yielded a fixed type and that all the crosses in which American—either newly imported or from the stock introduced in 1829 and now grown as a field crop in certain parts of the district—figures as a parent have proved disappointing and this too, whether the other parent has been American or indigenous except only in the case of American + Sea Island and American + Egyptian crosses which appear to be promising; there will however be some difficulty in fixing a cross between varieties so distinct.

A cross between Bourbon (tree) cotton and Egyptian is also very promising but is yet only in the second generation.

As for attempts to improve the indigenous (Kumpta) variety these have, as in all other cases, taken two directions namely selection alone and crossing. Selection alone appears to promise well. Of crosses the first was produced only last year and nothing definite can therefore be said about it. There is however no reason to doubt that results comparable with those obtained at Surat will ensue here also.

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* Universally but erroneously called Gossypium hirsutum, Linn. (et. Mill.); its correct designation is G. tricuspidatum, Lam.

Crosses with Kumpta were made in the season of 1905-06 but the monsoon failed and the work was thus retarded. The crosses with American were produced at Poona and transferred to Dhárwár. This accounts for the fact that no cross very likely to produce results has so far been secured on this Station, though crosses with Kumpta appear to promise well.

With regard to the crosses at Dhulia which are intended for the improvement of Khándesh cotton little can be said except that they are also disappointing. They were all made at Poona in 1901 but had for the most part the long stapled herbaceum varieties of Gujarát and Southern Marátha Country for one of the parents. This, I think, is a mistake, the resulting cross being too late to mature within the growing period at Dhulia.

I have therefore commenced experiments with a view to ascertaining the rules, if any, that apply to the way in which the various characters of the two parents appear or disappear in the off-spring. Definite rules are now known to be followed in the case of many plants, *e. g.*, wheat, but so far as experiment has yet gone many of the characters in the case of cotton appear to be complex and some difficulty will probably be experienced in this case.

(*b*) *Distribution of selected cotton seed.*

In the year under report some 30 tons of seed of the Lálio variety, selected by the Department was distributed in the Ahmadabad District. This distribution was especially welcome to the cultivators owing to a scarcity of seed following on last year's poor crop.

In certain parts of the Dhárwár District that are favoured with early rains, the demand for Broach seed introduced by the Department is considerable. The Broach variety is probably the parent of the local Southern Marátha Country variety (Kumpta) which now differs from it somewhat in the character of the cotton but chiefly in having a ginning outturn of only 25 per cent. as compared with the 33 per cent. of the Broach variety. The latter, when grown in the selected parts of the Dhárwár District, gives a heavier yield of seed cotton than the Kumpta variety and this seed cotton contains much more cotton and therefore, since the qualities are not very different, sells at a better price; for instance at Dhárwár when Kumpta sells at Rs. 112 per 1,344 lbs. of seed cotton, Broach (Dhárwár grown) sells at Rs. 132. The growth of Broach must, however, be restricted to those parts of the Dhárwár District which receive early rains, since it must be sown in July (the Kumpta variety is sown in September). These parts consist mainly of the tálukas of (1) Dhárwár, (2) Hubli, (3) Bankápur, (4) black soil area of Ránebennur, and (5) portion of Ron where early rains are sure.

It appears improbable that even in these selected tálukas the Broach variety will uphold its ginning percentage, but periodical consignments of seed from Gujarát can be imported. The ginning outturn, it may be mentioned, depends in any one variety very largely on the water-supply and increases within limits as this supply increases. The rainfall received by cotton planted in July is less in the Dhárwár District than the amount ordinarily received by cotton at Surat; hence the higher percentage in the latter district.

During the year under report some 800 lbs. of Broach seed was distributed in the Dhárwár District and for the coming season some 2,500 lbs.

It should be noted that this is not the case of distribution of the so-called selected seed but is really a substitution of one variety for another.

With regard to the question of selecting seed in large quantities from cultivators' fields, I have several times put on record my opinion that little good can result from this except possibly in cases where the tracts put under two different varieties join and where in consequence the seed of these two varieties becomes mixed at the gin; such cases are to be found in the Dhárwár District where Dhárwár-American and Kumpta are grown in close proximity to one another and again in the Ahmedabad District where the same statement applies to the Lálio and Wágad varieties. Even in these cases the cultivator can do the selection equally well with, and much more cheaply than, this Department.

The only method of inducing a real improvement in the existing variety of a district by selection alone, is to examine and secure seed from individual plants that show superiority in either yield or quality of cotton. This is already being done so far as the existing staff will allow but the quantity selected annually must from the nature of the work remain small.

(*c*) *Investigation of Khándesh Cotton.*

This work is necessarily confined to the Dhulia Station. The investigation of this cotton is, I consider, one of the most important lines of work of the Agricultural Department. The mixture of varieties grown—all of which differ botanically from those producing the best cotton of the Presidency, *viz.*, Surtee-Broach and Dhárwár (both Kumpta and Saw-ginned)—produces the bulk of the Indian cotton being grown over an area of 12½ million acres, *i. e.*, about 70 per cent. of the total area under cotton in India. Though the quality of the produce depends to a certain extent on its place of growth, whether in the Bombay Deccan, Central Provinces, United Provinces, Punjáb or Sind, I have proved in my Note on

the "Cottons of the Bombay Presidency" that the quality depends principally on the proportion in which the different varieties occur in the mixture. Further investigation confirms the conclusions drawn in the above-mentioned Note. The first point to gain in attacking the question was to isolate the various varieties, grow these separately and compare the yields and quality of the produce. This is a matter that cannot be disposed of in one season especially with the abnormal monsoons now prevalent and on a newly established Station. A beginning on definite lines has however been made and these are indicated below.

The six chief components of the Khándesh mixture we may call :—

Name of type.	Character of plant.		Botanical name.
1 Jari A	Narrow-lobed leaves	Yellow flowers.	1 G. Neglectum vera.
2 Jari B	Broad „ „		2 „ „ „ Malvensis.
3 Jari C ...	Do. „ „		3 „ „ „ Kathiawarensis.
4 Bani	Do. „ „		4 G. indicum.
5 Varádi A	Narrow „ „	White flowers.	5 G. neglectum rosea.
6 Varádi B	Broad „ „		6 „ „ „ Cutchica.

In the year under report a small area was sown with each of these varieties the seed of each having been picked separately from marked plants in the previous season in fields growing the mixture. The details are given below :—

Name of type.	Average per acre.		Percentage of cotton in seed cotton.
	Number of plants.	Yield of seed cotton.	
		Lbs.	
1 Jari A	1,190	30	31·6
2 Jari B	200	1½	25·6
3 Jari C	5,190	90	28·5
4 Bani	190	1¼	24·2
5 Varádi A	12,850	310	38·7
6 Varádi B	14,320	420	35·7

Nos. 2, 3 and 4 are doubtfully distinct botanically; they produce cotton worth about 3 per cent. more than the rest.

It is apparent therefore that it is the variety giving the highest ginning outturn that gives also the cotton of the least value while the yield per plant of these varieties is greater than in the others. Further it is this same variety that in certain tracts, where the cultivators are noted for progressiveness, is specially selected from the mixture by the cultivators for seed purposes. The reason for this is that in the first place this variety is easier to pick and the season during which picking lasts is shorter, while the yield is good and the higher ginning outturn combined with the cleanness of the cotton may more than counterbalance its lack of staple so far as the price of seed cotton is concerned.

It is thus obvious that there are many conflicting qualities and interests to be taken into account in attempts to improve this, or indeed any, cotton but in the case of Khándesh cotton the difficulties would appear to be more numerous than in other cases. Again the short stapled rough cotton (Varádi A) that is most popular with the cultivator is largely used for mixing with wool for which purpose roughness is an advantage and it appears to be a question whether, in attempts to increase the cultivators' profits, it is advisable to aim at a softer and longer staple or at a still rougher but longer one. It would be safer to work separately in both these directions.

The crosses that have been so far produced on the Dhulia Station have already been treated of above.

II.—Tobacco.

5. On the Nadiád Station tobacco is the principal crop. The tobacco grown in this district is extremely coarse and used only for local consumption. Attempts to improve the quality and make it suitable for European consumption take the following directions :—

(1) Hybridization with Sumatra and other varieties.
(2) Manurial treatment.
(3) Curing.

Of these probably curing is the most important and for experiments in this a curing house has just been completed. In this it should be possible to obtain data which will show how in rough sheds, the cultivator can produce a better product than that now turned out as the result of open air curing. In the latter process much damage is often caused by an untimely shower while the leaf is lying on the ground.

Hybrids with fine leaved varieties have been grown for many years at the Station but the fineness of the leaf disappears after a few seasons owing possibly to over manuring. Experiments with various manurial treatments have therefore been initiated. The leaf from these will constitute material for the curing experiments.

III.—Potatoes.

6. In several districts the growing of potatoes as both a kharif and rabi crop is an important industry. The following statement gives the area under this crop in the chief potato-growing tracts :—

		Acres.
Násik	District	230
Nagar	do.	106
Poona	do.	4,032
Sátára	do.	331
Belgaum	do.	91
Dhárwár	do.	186

Though the area is comparatively small the per acre value of the crop, which may reach Rs. 200, combined with the fact that the crop has no keeping qualities, makes experiment desirable. The seed is obtained by cultivators from Italy, about 5,000 tons being imported annually into Bombay. The produce from this is as a rule not sown more than once owing to rapid deterioration. Even the first crop rapidly decomposes in the store. A large number of French and other varieties are now being tried at the Dhárwár Station with the object of obtaining a drier potato with better keeping qualities.

IV.—Food-grains and Oil-seeds.

7. The establishment (two Fieldmen) for dealing seriously with the breeding of crops other than cotton was only sanctioned at the end of the last season when it was too late to commence breeding experiments. The interval has been occupied in collecting such preliminary information on the status of the various crops to be dealt with as is necessary for the work in hand. The crops to be manipulated include wheat, Jowár (sorghum), Bájri (pennisetum), Til (sesamum), Tur (cajanus) and groundnut.

Up to the present time attempts at improvement have, for want of trained subordinates for the work, been confined to plant to plant selection. This, with the crops named, can produce little effect in the case of food-grains, because the cultivator is an excellent judge of these and already practices selection; in the case of the oil-seeds (except groundnut), because, without chemical analysis, an increase in yield of seed and not of oil can alone be procured by selection.

V.—Groundnut.

8. There is only one variety of this crop commonly grown in this Presidency and this has been selected by cultivators to a certain extent. A search for a more profitable variety has been made and practically all the varieties known are now being cultivated at Dhárwár and Surat. All the varieties appear to be very seriously attacked by *tikka* disease (Septogtaeum arachidis) but some of the earlier ones hold out promise of escaping very serious damage owing to their earlier period of ripening. Probably the most prolific one is the one obtained from Mozambique. This variety is of the erect kind and bears an abundance of nuts clustered round the base of the stem and moreover not deeply buried in the soil; it is thus extremely easily harvested.

During the year under report the following quantities of different varieties of groundnut was distributed to cultivators :—

Pondicherry	... 5 tons.
Large Japanese	... 5 tons.
Spanish	... 5 tons.

In certain districts the foreign varieties are very popular and are to a certain extent cultivated from seed that has survived from the previous attempts to improve and encourage the cultivation of this crop. Probably no further importation of seed will be required for some years to come.

The problem with this crop is to obtain a variety that is resistent to the disease mentioned and breeding experiments to this end have been commenced.

Experiments with fungicides have so far given entirely negative results.

VI.—Sugarcane.

9. During the past two seasons I have made experiments on cultivators' fields in the use of artificial nitrogenous manures on sugarcane both in Southern Gujarát (Jalálpor táluka) and in Khándesh (Chálisgaon); in the year under report an experiment was also made near Poona. In all cases the results indicate that amonium sulphate at least can very profitably replace half of the very heavy and expensive dressings of organic material now alone applied. So obvious was the effect produced that the cultivators who saw it (including the owners) were eager to buy the sulphate. Their requests have as far as possible been complied with.

Amonium sulphate can be delivered in Bombay at £13 per ton and at all the experimental stations at under £14. Of course if full wagon loads were carried (say 8 to 10 tons) the cost would be less. This would be feasible if the demand increases and the depôts are opened by the Department.

VII.—Investigation of the role played by manures.

10. During the year under report I found time to continue an investigation on this point which had been retarded since my arrival in India by the large amount of administrative work involved in organizing and enlarging that part of the Agricultural Department for which I am responsible.

The results so far obtained are now in the press as a Memoir of the Imperial Agricultural Department.

They may be summarized as follows :—

(1) The so called exhausting effects of a crop on the soil are not due, as hitherto explained by the Chemist, to the exhaustion by the crop of the plant food in the soil, but to the excretion by the plant into the soil of a basic substance, alkaloidal in nature, which is extremely toxic to growing plants.

(2) The substance excreted is the same for plants of very different botanical affinities and probably for all plants.

(3) This substance is precipitated in a very insoluble state by all the common artificial manures and its effects are neuteralized by the addition of such substances as lime, ferric oxide, carbon black, clay, etc.

(4) This process of excretion dominates the rotations, crop mixtures and cultural methods practised in the Presidency and explains such hitherto obscure practices as manuring with astringent leaves, burning of seed beds for rice, etc.

VIII.—Training of subordinates.

11. All my subordinates, except three, have had less than 5 years' experience of experimental work; much attention has been paid to the training of those who have recently passed through the agricultural course and several of these may be now said to understand their work and to show promise of becoming capable members of the Department.

IX.—Agricultural Exhibitions.

12. Besides other smaller ones a large exhibition was held at Surat in March last in connection with the Industrial and Agricultural Exhibition. Exhibits were put up by this Department which undoubtedly aroused the interest of the very numerous cultivators who visited it. In all some one thousand items were exhibited by the Department and each was briefly described in a catalogue printed in English and Vernacular. The exhibits were intended by me to serve as a nucleus for a permanent agricultural museum which, taken in conjunction with the catalogue (revised from time to time) should serve as an educational agent for the cultivator and the student. Only local material was employed for the most part with the intention that the agriculture of the whole Presidency should be gradually illustrated in a systematic and descriptive manner.

F. FLETCHER,
Deputy Director of Agriculture.

Poona, September 1907.

(B) Stations under the Professor of Agriculture.

The experiments detailed below were planned and largely carried out by Mr. J. B. Knight; I was in charge only during their last stages.

2. The following Stations and sub-Stations were under the direction of the Professor of Agriculture during the year under report :—

No.	Name of Station.	Height above sea level.	Date when established.	Area of Station.	Kind of soil.	Rainfall.	
						Average	1906-07.
1	2	3	4	5	6	7	8
		Feet.		Acres.			
1	Poona	1,850	1879	66	Medium black ...	31·92	18 62
2	Mánjri (Poona District) ..	1,850	1894	62	Do. ...	27·00	...
3	Lonavla (do.) ...	2,039	1904	25	Light ..	186·56	135·72
4	Páramati (do.) ...	1,774	1906	5	Medium black ...	21·70	22·86

3. Experimental work was a continuation of that of previous years which included—

(1) At Poona the experiment on Tur and wilt diseases.

(2) At Mánjri experiments on the cultivation of sugarcane.

(3) At Lonávla, etc., experiments in the cultivation of rice.

(4) Demonstrations were commenced at Bárámati of sugarcane cultivation and growing under irrigation a better cotton than the one there local.

Wilt disease (Nedeosmos Pola) in Tur.

4. The results of the last two seasons show no signs of any real superiority in resistance in any particular variety, since the varieties that do best one year do badly the next. A careful examination of the results shows that the apparent superiority shown so far by any variety is due to its position in the field.

Gram is attacked by the same fungus as Tur.

Tikka disease (Septogtaeum Arachidis) of Groundnut.

5. The same remarks apply to these experiments as in the case of Tur. Neither of the treatments tried (steeping seed and spraying) can be said conclusively to have had any effect, the yields decreasing on an average from west to east owing either to differences in the soil or to the fact that to the west was a heavily irrigated guinea-grass plot from which the groundnut in that direction derived water.

The only practical method of dealing with these three fungoid diseases is the breeding of resistant strains.

Sugarcane.

6. In the year under report artificial manures, *viz.*, sulphate of potash, superphosphate, nitrate of soda, crude nitre were applied to ratoon cane from the plant canes that received the same manures (but in larger quantities) in the previous year. The results indicate that the above artificial manures will pay on this crop and that too, though the dressing of nitrate of soda was in my opinion much too heavy, as much as 2,264 lbs. per acre to plant canes and 1,191 lbs. to ratoons, and applied in the year under report in as many as 21 dressings. For future experiments a different treatment has been planned.

Rice experiments.

7. These experiments are for the purpose of finding a possible substitute for the practice now in vogue of burning tree-loppings in the seed-beds. The results are unreliable as the site is unsuitable. To convince ourselves of this it is only necessary to compare the yields from seedlings grown under a particular treatment when transplanted into the general area with the yields from seedlings similarly treated when transplanted in their own seed-beds.

Safflower cake appears to be a possible substitue for burning brush-wood in the seed-bed, but it is doubtful if it can be conveniently diverted from its present use as cattle food.

With regard to these experiments on the use of leaves and branches in burning seed-beds for rice, I believe that it is unnecessary to transplant the seedlings at all. It suffices to weigh the seedlings from the various beds and this obviates all differences in the area into which they are transplanted. This year (1907-08) I have done this with the following results :—

Treatment.	Average weight of seedlings (in grammes).			
	Weight per plant in each of the triplicate plots.			Mean of all.
	A.	B.	C.	
Safflower cake	0·4097	0·4967	.....	0·4532
Ain ráb	0·0879	.....	.....	0·0879
Mixed branches ráb ...	0 2781	0·1708	0·1430	0·1773
Ashes of mixed branches ...	0·0797	0 1094	0·0954	0·0948
Cowdung ploughed in ráb ...	0·0928	0·0772	.....	0 0850
Cowdung ráb	0 2561	0 3172	.....	0 2866
Earth pulverized	0·0909	0·0625	0·1000	0·0845
Earth heated	0·3562	0·2968	0·2276	0·2935

Much more work on this question of "ráb" is required for a final statement but this should be done under better conditions. I personally believe that the question is not one of supplying plant food materials but of neutralizing the poisonous excreta from the roots of the plants. This is the conclusion I have drawn from pot experiments during the past year. The effect of safflower cake should be specially studied from this point of view.

Rice experiments at Karjat and Thána.

8. The experiments were inconclusive. They were intended to test the use of artificial and other manures on rice in the fields in contradistinction to the seed-bed treatment at Lonávla.

Demonstrations at Bárámati.

9. The fields from Broach cotton under irrigation proved that good results can be obtained and this though the season was not good.

The sugarcane cultivation was not carefully carried out. Mr. Bhagwat, the officer in charge, suffered from ill health and hardly appreciated his responsibilities.

F. FLETCHER,
Acting Professor of Agriculture.

Poona, September 1907.

The Civil Dairy at Kirkee, established in 1890, continued in charge of Mr. Knight.

2. The principal objects of the Dairy are:—
   (1) to afford instructions for the students of the College of Science;
   (2) to serve as a model dairy to the public;
   (3) to give opportunity for experiments in feeding and dairying;
   (4) to improve dairy breeds;
   (5) to supply pure milk to the invalids and children of Poona;
   (6) to allow owners of milch cattle the free services of good bulls;

3. The Dairy was seriously handicapped in this year's work owing to outbreaks of two contagious diseases, *viz.*, foot and mouth disease and rinderpest. No animals were lost from the former, but their milk yields were appreciably reduced. Rinderpest was very common in the district and as a precautionary measure the entire herd was inoculated. But even in spite of the three inoculations done 18 animals were attacked and 10 succumbed to this deadly disease. Among the cattle kept at Manjri Kuran, which had also undergone two inoculations, there were 34 attacks, but the mortality was less as only four died. Twelve buffaloes aborted soon after the casting for inoculation, rendering them useless for the season.

4. The cattle consist of the following breeds:—

Cows—Aden, Sindhi and Gir.

Buffaloes—Jaffrabádi, Dehli, Kaira or Surti and Varadi or Dekkani.

The total number of cows and buffaloes was 86. The average yearly yield per cow was 2,038 lbs. and per buffalo 1,887 lbs.

5. The daily milk yield of each animal continues to be carefully recorded. This record is mainly intended as a guide for breeding purposes and it is in this direction that most progress has been made. The Sindhi cows have been bred continuously for about 11 years and we now have 29 farm bred heifers and cows; of these, 17 are in milk. Pitámbari (3,307 lbs. average for eight years) stands first, Bulákhi as a three-year old gave over 4,000 lbs. and had her second calf without going dry a day; Giti with 3,400 lbs. as three-year old are some of the most promising. The Dairy is necessarily worked to some extent on experimental lines and economy must at times be sacrificed in the interest of investigation and instruction.

6. *Fodder Farm.*—Fodder for the Dairy cattle was grown on the Agricultural College lands. The total area cropped was 75 acres.

7. No feeding experiments were carried out during the year.

(C) Stations under the Economic Botanist.

The Ganeshkhind Station.

The Ganeshkhind Botanical Garden was established in 1873, abandoned in 1885 and re-established on 1st October 1904. Its area is 80 acres.

2. The rainfall was seasonable except during the past hot weather when an excess was registered. The total rainfall recorded was 25·85 inches against an average of 32 inches.

2. The soil towards the river on the north is composed of a great depth of reddish alluvial loam. Three of the plots to the southward are of inferior *murum* soil. For the purposes of botanical teaching a large number of specimen plants were introduced into plots Nos. 7 and 8 some years ago. The majority of these are doing well. Those which are

intolerant of drought or require more attention have been transferred to more suitable positions.

4. *Ceara Rubber.*—The average increments in growth and girth of these plants still continue to increase in a satisfactory manner. We have come to the conclusion, which is contrary to the current opinion, that in the Deccan it is better to sow seeds *in situ* than to transplant seedlings.

A report and valuation on the rubber of *Cryptostegia grandiflora* is favourable enough, but the chief objection to the plant as a rubber-producer is that it yields so little.

Castilloa elastica, Hevea Braziliensis refused to grow in the Deccan.

Funtumia elastica grows very slowly and it still seems to be a doubtful point whether it be worth trying at all.

Mr. Burkill reports that our sample of rubber from *Ficus elastica* contains much less resin than the trees of the Government plantations of Assam. This is interesting information, but there are three valid reasons why the cultivation of this plant should not be taken up seriously :—

(1) Twenty-five years elapse before it is fit for tapping.

(2) It is very apt to die off then, if carelessly treated.

(3) The yield is always small, if we calculate it on the space which the plant occupies.

5. *Jute.*—The first trial on the cultivation of Jute was carried out. There are no inherent difficulties in the way beyond the necessity for sowing the seed in April and the consequent need of irrigation for two months afterwards, which will always restrict the cultivation of this plant to the neighbourhood of canals where it may be used in a rotation scheme with sugarcane.

6. *Rhea or Ramie Fibre.*—The Deccan and also the Konkan are unsuitable for the cultivation of this valuable plant and further experiment is considered as hopeless.

7. *Sisal.*—The Sisal hemp plant requires as good cultivation as any other crop if it has to yield a profit; and the current idea that it will grow anywhere and anyhow is not borne out by our experiments.

8. *Malachra capitata* might succeed in the vicinity of Bombay as a substitute for the jute plant, but it holds out no promise in the Deccan.

9. *Cotton.*—Special investigations in the botany of the cotton plant have been continued and an attempt was made to estimate the average yield per plant of every variety grown. The plots of four American tree cottons were maintained. Messrs. Tata & Sons valued the Bourbon cotton at the same rate as for Fine Broach at the same date. The cotton of the Soft Peruvian was valued at Rs. 392 as against Rs. 272 for the best Broach.

10. *Camphor* (*Cinnamomum Camphora*).—We now find that the camphor plant does not require shade but thrives best when sheltered from the wind and within reach of water. It will probably succeed best with us as a hedge under irrigation.

11. *Silo.*—Twenty-six thousand pounds of coarse grass were placed in a pit in September and furnished 20,000 lbs. of ensilage when the pit was opened in March. The product was favourably reported on and the experiment is to be repeated on a larger scale.

12. *Fruit Cultivation and minor Field Crops.*—For many years this Garden was practically a large barren *mango* grove. It was considered that the trees were held in check by excessive irrigation accompanied by an equally excessive growth of rank pasture grass. By withholding irrigation and keeping the ground as clear as possible the trees which were allowed to remain are now fruiting well.

13. Seven varieties of selected *pomegranates* are setting fruits in the second year from seed.

14. *Oranges and Lemons* of many varieties are doing well in spite of the ground becoming infested with *kunda* grass.

15. *Yams.*—A number of yams have been grown for several years and the best of these have been selected for further trial.

16. *Sugarcane.*—Mr. Meggitt, the Agricultural Chemist, has selected a small plot for growing sugarcane with the intention of personally selecting individual canes by chemical and other methods for propagation. Very valuable results have been obtained by these methods in the West Indies, and there is no reason why equal success should not be attained in India.

17. *Bhâdli.*—Enquiries were instituted on the identity of this crop and it is proved that every sample belonged to one or other of the three varieties of *Setaria italica.*

18. *Wheat.*—The wheat manure scheme was abandoned owing to the unsuitability of the soil. Valuations were received on the wheat crosses and varieties evolved during the past few years and the verdict of the expert merchants was that very few of them met the

requirements of the trade. Those which were favourably reported on have been selected for further trial.

19. A number of plants new to Poona were introduced into the Gardens. Considerable improvements in the general appearance of the Garden were effected during the year. We can never aspire to the distinction of having an ornamental botanical garden as the energies of the staff are mainly devoted to the development of economic and research work.

20. The *Museum* collection now consists of 500 species of seeds, 500 samples of cotton and about 1,000 miscellaneous economic products.

The Bassein Station.

21. The Bassein Botanical Gardens and Experimental Station (area 90 acres) was established in February 1906. The work of clearing out the rank vegetation was commenced at once and will continue for some time yet. At the especial desire of Mr. Cousens, the Archæologist, a small area has been left in its original condition and I came to a definite understanding with him regarding the preservation and treatment of the ruins. The soil of the Bassein garden is a sandy alluvial loam similar to the *bágáyat* land which forms the fertile belt along the coast in the district. The low lying open stretch of land within the Fort has been used for fibre and rice experiments. The old gardens belonging to the various Monasteries and Churches are again established as experimental grounds. The Fort is covered with a network of old roads. Some of these have already been made fit for wheel traffic and no absolute new roads will probably be ever required. The few open spaces which exist within the Fort are being laid down as lawns.

22. The rainfall during the year was below the normal but it proved amply sufficient, because the rain seemed to fall exactly when required. The total is 58·59 inches against an average of 83·53 inches. There are a large number of wells within the Fort and the water of 14 of these, which are now in constant use, were analysed by Mr. Meggitt, the Agricultural Chemist, in October and again in June. Of these only two have been declared unfit for use.

23. The *Ceara* rubber plants put out as seeds and seedlings in May 1906 made excellent growth, individuals varying in height from 7½ feet to nearly 16 feet.

The *Castilloa* and *Hevea* made but little progress.

24. Of 8 varieties of *cottons* grown only the Bourbon promises good results. A small plantation of nearly an acre has been made for the sake of obtaining results on a larger scale but a year or two more must elapse before a definite report can be given. There is no prospect of success in the cultivation of the annual varieties of the Indian cottons.

25. A set of 50 varieties of *Cassava* have been maintained and experiments with small *millets*, *beans* and *guavas* were unsuccessful but require repetition.

26. Trials are being commenced with local and other forms of *plantains*. There is some prospect of success in the cultivation of Lemon grass for its oil-producing qualities.

27. *Pineapples* also promise well.

28. *Sterculia fœtida* was tested as an oil-producing plant and the analysis supplied by Mr. Hooper proves that the plant may be worth growing.

29. Suckers of the four principal *agaves* in the Bombay Presidency were put out but no remark can yet be made concerning them.

30. The result of the *jute* experiment is disappointing but on the advice of the jute cultivation expert the trial is being repeated this year on higher ground.

31. In addition to the above mentioned cultural experiments the following are a few of the plants on trial:—the Vine, Pomegranate, Sapota, Pumelo, Coffee, Nutmeg, Cocoa, Cinnamon, Camphor, etc.

32. One year's trial of *rice* grown by local methods proved that early and not late varieties should be experimented with in this district.

33. A set of specimens to illustrate the botanical products of the Presidency have been brought together and we hope in time to have a good *museum* of economic products.

G. A. GAMMIE,
Economic Botanist.

Poona, August 1907.

(D) Station under the Second Deputy Director of Agriculture.

The work on the Mirpurkhás Station (area 52 acres), which was started in 1904, presents no great outstanding features during the year of report and was if anything inferior in results to the season 1905-1906.

2. Dealing first with *Egyptian cotton* the following conclusions are derived from a study of this crop on the Station :—

(1) Importance of early and careful sowing; many blank spaces mean so much less total yield. This is best obtained by sowing on ridges.

(2) Importance of getting soil into good condition before sowing by green manuring or by other means.

(3) Metaffifi is more suitable than Abbassi for Sind.

(4) With proper care in its cultivation—the conditions of Sind being so like those of Egypt—Egyptian cotton can be made to pay extremely well. If, however, it is broadcasted on the flat, after one ploughing and deluged with water every few days as is the practise of the average Sindhi cultivator, its growth will not be a success. It would be better to cultivate local Sindhi cotton which is much hardier.

The best Egyptian cotton yield on the Station was in plot No. 17 which gave a yield of 677 lbs. seed cotton per acre.

The fibre was said to be equal to that of average Egyptian and the price obtained was Rs. 14 per maund of 80 lbs. for best quality.

A subject of experiment in the future will be (1) the influence of growth in Sind for several years on the fibre and (2) also some manurial experiments in order to hurry the cotton through the season of the hot winds and hasten the ripening of the crop.

When the production of Egyptian cotton is increased there will be a large supply of cotton seed. This cotton seed is valuable for the amount of oil it contains, and it is reasonable to suppose that in the future oil extracting plants will be set up, thus forming a valuable bye-product. The following is a comparison between the oil contents of Abbassi cotton seed grown in Sind and local Sindhi cotton seed :—

	Abbassi cotton seed.	Sindhi cotton seed.
Oil	25·18	17·14
Albuminoids	19·37	15·19
Fibre	15·35	18·16
Total nitrogen	3·31	2·57
Albuminoid nitrogen	3·10	2·43

3. *American Cotton.*—A large number of American cottons have been tried on the Station. There has not been time yet, however, to form any definite idea of their suitability for Sind. But generally they do not seem as suitable as Egyptian cotton.

4. *Tree Cottons.*—None of the varieties tried on the Station have done well. The period of hot winds delays their growth and they then afford an easy prey to the white ants.

5. *Groundnuts.*—The physical texture of the Station soil is not suitable for groundnuts. On the whole they have not been a success when tried by cultivators in Lower Sind.

6. *Cereal Crops.*—Bájri, maize and Jowár call for no remark. The latter always suffers severely from the attacks of borer. The chief point to be observed in their cultivation is early sowing. When this is done, it gives a chance of successful re-sowing in case of partial failure of the first sowing.

Bullrush millet from Africa was very successful during the season on a small plot. It attracted much attention owing to the size of the ear-heads. The yield was 750 lbs. grain per acre.

7. *Wheat.*—The varieties grown were Delhi white, Nandero, Bubak, Punjab red, Sindhi red and Sindhi white. They were on the whole satisfactory though the yields were less than last year. The whole crop was a practical failure in Lower Sind owing to rust. Delhi white gave the best yield—1,520 lbs. per acre; it was closely followed by Nandero.

When wheat is grown in the rotation it takes the place of the rabi green crop and consequently it will be necessary to manure it. During the present season various trials will be held on the comparative merits of different manures and fallowing. The maximum number of waterings was three, and some plots only received two. According to results of trials with foreign wheats, the indigenous varieties are most suited to the soil.

The wheat crosses made on the Station were all badly attacked with rust.

8. *Saidi beans, gram, Russian linseed, lentils* and *Til* were all failures owing chiefly to the alkali content of the soil in which they were sown.

9. *Sugarcane.*—This crop did well and attracted much attention. A large proportion of the crop was sold to visiting zamindárs for "sets." Calculating from a measured guntha the yield per acre was 93,400 lbs. cane. One maund of cane (80 lbs.) gave 50 lbs. juice and 10 lbs. of Gur.

10. *Tur.*—This was one of the most successful crops of the season. One acre was sown in July and it resulted in a dense mass of foliage, about 7′ high, so thick that the pods could not be gathered till the crop was cut down in February. The yield was 1,624 lbs. of grain. It seems to offer great possibilities for Sind and will be more extensively tried.

11. *Fibre Crops.—Jute* and *San* were tried. Jute did not do well but San seems to have considerable alkali resisting powers and will be further experimented with.

12. *Berseem.*—Berseem or Egyptian clover was sown in about 6 acres. As it was only sown in December, however, the results are not nearly so good as they should have been. It is a most valuable fodder crop and is particularly suitable to grow in rotation with Egyptian cotton. Where water can be obtained the soil and climate of Sind seem suitable for its growth. It requires to be sown in September-October when it will give three good cuttings of excellent fodder.

13. *Senji* (*Melilotus indicus*) was grown in one acre. This plant is considered by the cultivators in Egypt as a worthless weed in the Berseem. The only animals that can eat it green without injury are mules and goats. It, however, leaves the land in good condition for succeeding crops.

14. *Date Palms.*—Thirteen varieties of date palms, numbering 303 plants, were planted on the Station. About one-half are dead and the remainder are only now showing signs of growth. They will be ready for distribution in a short time.

15. *Conclusion.*—The Station at present suffers from alkali or *kalar*. Few of the plots are quite free of this. In some, germination is so bad that practically no results can be obtained; this interferes considerably with experimental work. To remedy this a system of drains has been made, and this, combined with cropping suitable to the land, should remedy the defect.

G. S. HENDERSON,
Second Deputy Director of Agriculture.

Mirpurkhás, August 1907.

(E) Work by the Agricultural Chemist.

By far the greater part of my own time has been absorbed in teaching the students attending the agricultural course, the remainder being given to supervision and direction of the analytical work carried on in the Laboratory in connection with the various samples sent in for analysis from the Presidency Stations and other sources.

2. The amount of work entailed in such analysis has kept all my assistants fully engaged, the number being large and the nature very varied of the samples so received. The nature of the work done, and its extent, will perhaps be best gauged from the following digest of the samples received during the year ending 30th June 1907:—

Nature of samples.	Number received.	Nature of samples.	Number received.
Soils	67	Whole milk* ...	110
Waters	22	Separated milk* ...	123
Feeding stuffs	5	Cream*	123
Grasses	12	Butter	2
Oil-seeds	47	Gul	32
Manures	43	Miscellaneous	7
Rab materials	53		

*For estimation of fat only.

3. Other work done included—

(1) a preliminary investigation into the essential oil-yielding properties of certain odoriferous grasses and plants;

(2) analysis of the Sugarcane from the variously manured plots at Mánjri, and of the Gul resulting therefrom.

A. A. MEGGITT,
Agricultural Chemist.

Poona, August 1907.

APPENDIX B.

Visitors.

1. The following statement shows the number of visitors to the various Stations:—

Class of Visitors.	Surat.	Nadiád.	Dhárwár.	Dhulia.	Poona.	Mánjri	Bárámati.	Lanowli.	Mirpur Khás.	Ganesh-khind.	Bassein.
Cultivators	68	85	101	142	24	38	8	8	85	1	6
Government officers and others	50	33	59	131*	100*	241*	6	...	68	49	71
Total ...	119	118	160	273	124	279	14	8	153	50	77

* Includes numbers of students.

Distribution of Seeds and Implements.

2. The seeds and improved implements distributed are detailed below:—

Seeds.

Articles distributed.	Surat.	Nadiád.	Dhárwár.	Dhulia.	Poona.	Mánjri.	Mirpur Khás.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Cereals	556	11,968	474	57	155	4,213	260
Pulses	421	614	4	80	29	245	...
Oil-seeds	1,546	...	138	783	74	647	3,054
Cotton seed	13,055	8	5,798	285	38	42	20,328
Other fibre seed	5	25	40	...	.....	12	...
Garden crops and vegetables ...	58	315	...	...	10	4	6 gunthas sugarcane.
Fodder seeds	1¼	...	...	...	894 and 4½ bags guinea grass.	907 and 4 baskets sweet potatoes.	80

Implements.

Station.	Ploughs.	Harrows.	Hoes.	Seed drills.	Others.	Remarks.
Poona	2	8	3	3	*3	*Sugar mill, pan and cotton gin.
Surat	3 (Country) 8 (Turn wrest)	...	29	11	†16	†1 chaff-cutter rest hand gins. Besides 45 miscellaneous articles.
Nadiád	4	...	4	2	‡29	‡2 Samárs rest chaff-cutters.
Dhárwár	91 (Turn wrest)	...	...	...	...	
Dhulia	.....	...	...	...	§2	§Hand chaff-cutters.

Accounts.

3. The following statement shows the receipts and expenditure during the year at various Stations:—

Station.	Receipts.	Expenditure.	Net cost.
	Rs. a. p.	Rs. a. p.	Rs. a. p.
1. Surat	5,605 2 6	16,951 3 1	11,346 0 7
2. Nadiád	1,964 13 8	7,184 11 10	5,219 14 2
3. Dhulia	1,170 6 6	2,996 10 0	1,826 3 6
4. Dhárwár	3,036 14 9	11,911 10 3	8,874 11 6
5. Poona	1,398 6 2	8,973 7 5	7,575 1 3
6. Mánjri	2,631 5 5	13,375 7 10	10,744 2 5
7. Lanowli	109 4 0	1,768 7 11	1,659 3 11
8. Bárámati	.....	1,061 2 6	1,061 2 6
9. Ganesh Khind	658 7 3	5,290 5 8	4,631 14 5
10. Bassein	298 11 8	14,818 14 2	14,520 2 6
11. Mirpur Khás	1,437 2 9	12,580 5 4	11,143 2 7
12. Surat Dairy	4,173 3 3	4,866 11 6	693 8 3
13. Kirkee Dairy	22,831 8 2	27,467 9 8	4,636 1 6
14. Sirsi experiments	22 10 5	46 9 9	23 15 4
15. Tree cotton experiments ...	10 11 5	740 0 0	729 4 7
Total ...	45,348 11 11	1,30,033 4 11	84,684 9 0

These figures represent actual receipts and expenditure in the year. Increases or decreases in valuation of live and dead stock are not taken into account. Extended experiments with costly artificial manures have reduced profits at Mánjri, but this is unavoidable. The Dairies alone can be run commercially and the Kirkee Dairy account includes experimental and educational charges. Care has been taken to see that Superintendents sell their farm produce to the best advantage but fair prices cannot of course be obtained for small parcels of produce.

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No. A.-5822 of 1908.

From

G. F. KEATINGE, Esquire, I. C. S.,
Director of Agriculture, Bombay,
Poona;

To

The Chief Secretary to Government,
Revenue Department, Bombay.

Poona, 29th September 1908.

Sir,

I have the honour to submit herewith the Annual Report of the Department of Agriculture for the year 1907-1908 ending with June 30th, 1908.

CHAPTER I.

Prefatory.

2. The various posts in the Department enumerated below have been filled as follows:—

Director of Agriculture—July 1st to December 2nd, Mr. Mead; December 7th to June 30th, myself.

Principal, Agricultural College—November 16th to June 30th, Dr. Mann.

Agricultural Chemist—July 1st to November 15th, Mr. Meggitt; November 16th to June 30th, Dr. Mann.

Professor of Agriculture—July 1st to September 6th, Mr. Fletcher; September 7th to June 30th, Mr. Knight.

Economic Botanist—Throughout the year, Mr. Gammie. In December, however, Mr. Gammie was appointed Cotton Specialist to the Government of India and since then he has continued to hold charge of the duties of Economic Botanist only pending the arrival of a successor.

Deputy Director—July 1st to September 13th, Mr. Fletcher; September 14th to June 30th, Mr. Main.

2nd Deputy Director in Sind—Throughout the year, Mr. Henderson.

Supernumerary Agriculturist—July to February, Mr. Garrad; May and June, Mr. Roberts.

We have lost

Mr. Meggitt—transferred to Eastern Bengal.

Mr. Fletcher—gone to Egypt.

Mr. Gammie—transferred to the Imperial Department of Agriculture.

Mr. Garrad—retired, owing to ill-health.

We have gained

Dr. Mann,

Mr. Main,

Mr. Roberts,

and the post of Economic Botanist is still to be filled. The superior staff of the Department has thus undergone a fairly general change from the Director downwards, which has naturally involved a considerable break in continuity of work; and I may mention that since the close of the year we have suffered severely in the upper ranks from sickness. The changes amongst the Farm Superintendents have been, I am glad to say, far fewer.

CHAPTER II.

Agricultural Education.

3. I propose to deal first with the Agricultural College at Poona, our most ambitious undertaking, in which the future of the Department lies. The building of the new College is proceeding. The large laboratory block will be completed in a few months. The main buildings are steadily rising and will be ready a year later. The bungalow of the Professor of Agriculture has been completed. Plans and estimates for a hostel for the students are being prepared, and work in this direction will, I hope, soon commence. The buildings of the College Farm are completed and the Farm itself is developing rapidly. Meantime the College work has been conducted and the students lodged in hired bungalows. From November 25th, 1907, the College ceased to be a part of the College of Science, and was affiliated to the Bombay University as a separate College. On June 1st, 1908, the new classes under the revised curriculum prescribed by the Bombay University commenced and the following students attended :—

35 for the F.Ag. course,
37 for the S.Ag. course,
36 for the B.Ag. course,

the total number of students being 108 as against 95 of the year before. The new curriculum is more elaborate and comprehensive than the old one, and in order to fit the students who had allowed the first half of their course under the old arrangements to continue their studies under the new arrangements a supplementary term from January 13th to March 31st was held.

4. The University examinations were held in November 1907 with the following results :—

Class.	Appeared.	Passed.	Failed.
L.Ag.	25	21	4
S.Ag.	43	31	12
F.Ag.	32	30	2

Three F.Ag. students were put in the first class and all the rest of the students in the second class.

5. The following new appointments were made in connection with the College :—

Mr. H. M. Chibber as Assistant Professor of Botany.
Mr. H. K. Mehta as Assistant Professor of Physics and Mathematics.
Mr. G. K. Kelkar as Assistant Professor of Agriculture.
Mr. D. L. Sahasrabuddhe as Lecturer in Chemistry.
Mr. N. V. Joshi as Junior Laboratory Assistant.

6. In addition to the above, Mr. Dixon took the Zoology and Entomology, Messrs. Sanga and Sethna the Veterinary instruction, and Mr. Pátil the Practical Agricultural Demonstration, while Messrs. Price and Tahmane continued their work in the Chemical branch.

7. It is no easy matter to start a new College, and the difficulties were enhanced by the fact that many of the subjects were novel to Indian education, many of the staff new to the work, while the College had to be housed in hired bungalows pending the construction of the permanent buildings. I am glad to say that the staff have risen well to the occasion, and under the able and energetic direction of Dr. Mann have made a successful beginning. We owe much also to the past labours of Messrs. Knight, Gammie and Meggitt, which cleared the ground for our present endeavours. The students as a body display a keen interest in their work, though many of them complain that the course is more exacting than the Arts course which they deserted. This I can well believe to be the case. It is more difficult to learn, or, for matter of that, to teach the difference between good and bad crops than between good and bad grammar, and it requires more concentration and precision to defeat the armies of insect and fungoid pests than to speculate on the causes of defeat or success amongst the nations of the world. But if the labour is greater so is the reward; and I

venture to think that many of our students will turn out skilled scientific investigators and practical agriculturists, while for all of them the manifold processes of nature which take place in each cultivated field will have an interest and a meaning which formerly passed them by.

CHAPTER III.

Agricultural Stations.

8. *The Deputy Director and his charge.*—Up to the year under report the Deputy Director had held charge of the agricultural operations throughout the Presidency proper with the exception of those in or round Poona which were conducted by the Professor of Agriculture. During the year under report, however, the whole of the districts of Poona, Nagar, Sátára, Násik and Sholápur have been assigned to the Professor of Agriculture as a field for his operations, and the Deputy Director remains in charge of Gujarát, Khándesh, the Southern Marátha Country and the Konkan ; though the latter tract has hitherto received little or no attention.

The Stations under the Deputy Director are :—

Name of Station.	District.
1. Surat Agricultural Station ...	... Surat.
2. Surat Dairy Farm	... Do.
3. Nadiád Agricultural Station ...	... Kaira.
4. Muvália do. ...	... Panch Maháls.
5. Dhulia do. ...	... West Khándesh.
6. Dhárwár do. ...	... Dhárwár.

Sub-stations.	
1. Dumas	... Sachin State.
2. Hosur	... Belgaum.
3. Kelgeri	... Dhárwár.
4. Sirsi	... Kánara.

Arrangements have also been made or are being made to start several other small Sub-stations for experiments on jute, aloes, Broach cotton, American cotton, wheat and linseed. Land is also available at Gokák and Kárwár for new Stations, to open which only funds are needed.

9. Detailed reports of each Station have been separately published, and the principal results obtained are given in another part of this report; but I may here state that the development of those farms has been considerable, and a large amount of administrative work has in consequence fallen upon the Deputy Director. Mr. Main has devoted great care to his scientific work, and his summary of experimental work attached as an appendix to this report is of considerable interest. Under the headings "Well-boring," "Exhibitions" and "Seed-distribution" a further account of his activities will be found. He toured actively over his large charge, and in addition visited three Native States to advise on agricultural matters. He also submitted special reports on a number of matters, the principal of which were the adulteration of Broach cotton, the alkali lands in the Broach District and the crop experiments for 1905-1906 and 1906-1907.

10. *The 2nd Deputy Director and his charge.*—Mr. Henderson supervised the Mirpurkhás and Daulatpur Stations, looked after Egyptian cotton and berseem on the Jamráo Canal, arranged experiments in American cottons and toured actively in his charge, acquainting himself with agricultural conditions in Sind. He is a very practical agriculturist, and his Egyptian experience stands him in good stead in the analogous conditions of Sind. His work in reclaiming alkali land is likely to prove of much value to Sind, and he speaks with authority on the defective agricultural practice there. The remoteness of Sind from Poona will always be a bar to a close connection between the Deputy Director in Sind and the rest of the agricultural staff, and I regret to say that I have been able to give Mr. Henderson no assistance during the past year.

11. *The Professor of Agriculture.*—Mr. Knight's duties have been many. Apart from his duties at the College as Professor of Agriculture he supervised

1. The College Farm, Kirkee, Poona.
2. The Dairy Farm, Kirkee, Poona.
3. The Mánjri Farm, Poona District.
4. The "ráb" Station at Lonávla, Poona District.
5. Sugarcane demonstrations, Bárámati, Poona District.
6. Salt land reclamation, Nira Canal, Poona District.
7. Dry farming experiments, Ráhuri, Nagar District.

He toured in the Nagar and Poona Districts, paid a visit to Kolába District and took part in the Sangamner Show. He has put in a hard and useful year's work.

12. *The Economic Botanist.*—Mr. Gammie exercised his usual efficient supervision over the Ganeshkhind and Bassein Gardens throughout the year, and made trips to Gujarát and the Southern Marátha Country. He is severing his immediate connection with the Bombay Agricultural Department; but his past work will be a solid foundation for his successor to build on.

13. *The Agricultural Chemist.*—Apart from his work as Principal of the Agricultural College, Dr. Mann had his hands very full as Agricultural Chemist, but found time to visit Surat and the Nira Valley in connection with chemical investigations of soil, Mánjri in connection with the gul-making and Lonávla in connection with the ráb burning. The report of the work done by the Agricultural Chemist is printed as an appendix and shews a deal of useful work. With Dr. Mann in charge this branch is not likely to lag behind.

CHAPTER IV.

Some Noteworthy points in the year's work.

14. As usual cotton has absorbed a lot of our attention and it is disappointing to have to record a set-back in the expectations that have been previously formed in two important matters in this connection. I refer to the most advanced cotton hybrids on the Surat Farm and the Egyptian cotton in Sind, details of which are given in Appendices A and B. As regards the former, Mr. Main shews that considerable variation is going on amongst these hybrids, and that while the relative advantage in quality which the lint of some of them have over the ordinary Surti cotton is high, the ginning percentage is steadily falling. Whatever may be the point of view of the cotton trade, the object of the cultivator must be to grow the most profitable crop, and his profits depend not only on the quality of the lint but also on the quantity, which in turn depends on the outturn of seed cotton and the ginning percentage. We have not hitherto been able to grow these cottons on a sufficiently large scale to permit of a definite comparison of outturn per acre between the produce of these hybrids and the produce of ordinary Surat cotton. I hope that this will be possible in the current year, and it will then be time to think about the prospective profits; but until the hybrids shew greater signs of stability it is impossible to speak with precision; and we have to be content with the fact that many hybrids give good promise.

15. As regards Egyptian cotton in Sind the matter is dealt with at length in the report of the Mirpurkhás Farm, and has been the subject of a special report. As a result of climatic conditions, or in consequence of Mr. Lefroy's parásites, or for both these reasons, the damage by boll worm was comparatively small but the water-supply was deficient and the crop produced on the Jamráo Canal only moderate. Good prices were obtained at the Government auction though the Mitaffifi hardly fetched its proper value. Mr. Henderson is, however, convinced that Egyptian cotton will only pay the cultivator

(1) on lands quite free from salt;
(2) under far better cultivation than is usually practised in Sind;
(3) in rotation with berseem, as in Egypt;
(4) with a proper water-supply.

During the current year the water-supply was not available till long after the proper sowing season, and I fear that we shall have very bad results to report next year. It was also unfortunate that for various causes the Egyptian cotton on the Mirpurkhás Farm did so badly; and we still have to demonstrate on a large scale what are the net profits of Egyptian cotton, well cultivated under proper conditions, and that they contrast favourably with the net profits to be obtained from Sindhi cotton. I hope that we shall be able to undertake this next year.

16. For the rest it will be seen that various American cottons have done well at Dhárwár and in Sind, and Cambodias at Dhárwár and Surat, and we are justified in hoping for success in this direction.

17. In view of the comparative failure of Broach cotton under irrigation in the Deccan, owing to the faults in cultivation and irrigation on the part of the cultivators, the efforts which were made last year in this direction were not repeated during the year under report. We have, however, shewn that it can be grown at considerable profit, and when we can find time to take up the matter systematically and concentrate our efforts under effective supervision we shall make a further move in this direction. Meantime 12,000 lbs. of the best Navsari cotton seed have been distributed in the Ahmedabad District and the result will be of considerable interest.

18. Perhaps the greatest success of the past year has been in connection with the introduction of Broach cotton into the Dhárwár District described in detail by the Deputy Director, which offers a substantial advantage to the cultivator in parts of the Southern Marátha Country over the locally grown Kumpta cotton. It seems probable that it will be necessary to bring fresh seeds yearly from Navsari to the Southern Marátha Country; but this need offer no particular difficulty. In the present year 16,000 lbs. of Broach cotton seed from Navsari have been sown in the Southern Marátha Country in addition to some of the seed from the Broach cotton grown there last year. Steps are being taken to get the people to cultivate it properly, and steps will be taken to get them to adopt a cleaner system of picking. The results obtained will be carefully noted.

19. The successful growing of several varieties of foreign tobacco and the curing of tobacco on improved principles which we have now introduced on the Nadiád Farm are worthy of note. The prices offered for our tobacco by the Star Company, as detailed by the Deputy Director, are encouraging; but the economic value of this venture cannot yet be assessed.

20. The Department has for some years past been distributing and strongly recommending various varieties of foreign groundnuts in preference to the indigenous kind. They yield better, mature earlier and so escape the 'ticca' disease to a great extent, and command on the whole a higher price. These new varieties have now practically ousted the old kind from the Sátára District and are being grown on a large scale there and are quite established in the estimation of the people as having a distinct advantage. So much is this the case that we have ceased to distribute fresh seed in the Sátára District, as it is no longer necessary. We are now pushing the matter in the Násik and Belgaum Districts. There is probably a considerable future for these foreign groundnuts, and much work remains to be done in determining the variety best suited to various conditions. The facts as to the true value of some of these new varieties will shortly be published in the Press, with information about the localities in which they are to be obtained. Another point of interest in connection with groundnuts is their introduction into the Konkan and their successful cultivation as a subsidiary crop under plantains as detailed in the report of the Bassein Botanical Garden.

21. A full account of the results of the power cane-crusher will be found in the Mánjri report, and gives very promising indications pointing to the probability of a distinct cheapening of the crushing process as compared with the most efficient iron roller mills worked by bullocks. It must further be remembered that very many bullock mills are worked anything but efficiently, and that great loss of juice results therefrom. I hope during the present season to be able to experiment with a better pattern of power cane-crusher in the Nira Valley, where the people are most anxious to see one work.

22. The notes published in the Mánjri Farm report on the new gul-mould and the value of scum are interesting, and indicate lines of profitable work. Indeed, the whole of the complicated operations of cane growing, crushing, boiling and gul-manufacture offer a vast field for action. The practice in all these matters varies greatly from one locality to another, and our own methods have to be contrasted with each local method before we can present our facts to those concerned. I am convinced, however, that we have only to set our ideas in order and carefully study existing practice in different tracts to find that we are in a position to offer much profitable advice. This work will be taken up at once.

23. It requires an extended period of observation to estimate the economic value of new crops; but of the many plants new to this locality which are being tried at our Botanical Gardens lemon grass has given very good results at Bassein, while the jute grown at the Ganeshkhind Garden is more promising than was the case the year before (*vide* reports of the Bassein and Ganeshkhind Gardens). The large profits obtainable in the case of the former are remarkable and the question of attempting the extraction of citronella oil will be considered. Tapioca is another substance which has been receiving attention. Cassava has been growing satisfactorily at Poona for years, but has never been taken up by the cultivators in this Presidency. It is now being tried in several localities, and an effort will be made to estimate its exact value as a field crop under different conditions, and to push its use where it promises success.

CHAPTER V.

Manures.

24. It is disappointing that after some years' experience of many concentrated manures we should not yet be able to offer more decided opinions on the subject. This is in part due to the vagaries of recent seasons, and there seems to be little doubt that the application of concentrated manures to crops under irrigation offers greater chances of success than in the case of crops that depend on the rainfall. The three most noteworthy manurial results of the year refer to irrigated crops. A small top-dressing of nitrate of soda applied to wheat in Sind shewed a distinct profit, while in the case of tobacco the use of castor cake or nitre together with farmyard manure in combination with deep ploughing was most encouraging. In the case of sugarcane, on which we have been experimenting for years, sulphate of ammonia as a top-dressing has produced at Mánjri better results than any other artificial manure, a fact which was strikingly confirmed by the Chálisgaon experiments reported in the Dhulia Station Report. This is the first time that we have tried sulphate of ammonia on sugarcane, and the fact that its use gave large net profits is of the more interest in that it is likely to be manufactured in India before long. I will endeavour to obtain a more definite pronouncement of the comparative results of various manures on sugarcane so that we may be in a position to state definitely what we are prepared to recommend. I regret that I cannot make any such statement at present. We have during the past year considerably simplified our experiments in concentrated manures, and we hope to be able to offer more information on the subject shortly.

25. Two very remarkable results were obtained on the Surat Farm, shewing the advantages of applying night-soil manure to cotton and rotted cactus manure to jowári. The night-soil manure was applied in beds and trenches so long ago as 1904 but its effects are still most marked. In every case it gave a large advantage over the plots manured with farmyard manure, amounting to from 300 to 400 lbs. of seed cotton per acre; and the Deputy Director

considers it likely that the effect of this one application of night-soil will last for 10 years or longer. The application of rotted cactus to jowári has now for two years running given a net advantage of nearly 300 lbs. per acre over jowári grown without manure and a substantial advantage over jowári grown with farmyard manure.

CHAPTER VI.

Seed.

26. It is a matter of common knowledge that a sample of seed in the country frequently contains many different varieties which are all sown together; it is also commonly asserted that much of the seed that is sown is, for various reasons, of very poor germinating capacity. To ascertain the facts with regard to this important question it has been proposed to establish in connection with the Poona Agricultural College a seed-testing station; and I venture to think that when it is established it will be of great use and enable us to speak authoritatively on subjects on which at present we can only speculate. Meantime on our farms seed selection has been going on chiefly in connection with cotton and jowári. The Khándesh cotton mixture has been analysed and its six types sown separately. The seed from the first and second pickings of the Kumpta cotton on the Dhárwár Farm has been kept separate, and used as a nucleus to start a "Cotton Seed Association" which Mr. Herlekar is organizing in Dhárwár as a branch of the Dhárwár Agricultural Association. Samples of all the wheats grown in this Presidency have been collected and will be separately sown this year. Selection of jowári is going on. No one can see the magnificent jowáris that are grown in parts of this Presidency without realizing that it has taken centuries of careful selection to produce such results, and any improvement on this that we can effect by our efforts must of necessity be slow. However, lest it should be thought that we are not making adequate efforts in the matter of seed, I append below a tabular statement shewing the amount of seed which the Department distributed during the year under report :—

Kind of seed.	Quantity.	Kind of seed.	Quantity.
Cotton	67,780 lbs.	Pulses	1,818 lbs.
Jowári	9,339 „	Date-palm ...	446 seedlings.
Groundnut	5,942 „	San	422 lbs.
Sugarcane	5,245 sets.	Berseem... ...	201 „
Rubber	2,528 seedlings.	Jute	56 „
Paddy	1,087 lbs.	Others	4,216 „
Wheat	802 „		

CHAPTER VII.

Reclamation of Salt Land.

27. This problem has been seriously tackled during the past year. At Daulatpur in Sind operations have been commenced to reclaim 400 acres of alkali land classed as "Unculturable Kalar," and it is estimated that the work of 4 years will shew a net profit of Rs. 50,000. The *modus operandi* is to wash the salt off and through the soil and to grow rice at the same time; and the work is similar to that which has been successfully carried out in Egypt. At present it can only be said that a good start has been made. It is hoped that in the next few years this Station will incidentally demonstrate the advantages of intensive culture over the system of fallows in vogue in the locality.

28. At Dumas in the Sachin State a small experiment is being tried in reclaiming land which has been made salt by sea water. The difficulty here is not only to wash out the salt but also to keep out the sea.

29. On several of the canals in the Deccan salt efflorescence due to water-logging has occurred. Here the salts are brought to the surface and deposited there in the process of evaporation, and large areas of valuable land have been rendered uncultivable and further large areas have become less fertile, while it is feared that this process is continuously going on. The solution of the difficulty lies mainly in drainage, and as the country concerned is mostly undulating no special engineering difficulties are involved. In the worst cases where extent and depth of the salt is considerable, and the texture of the soil has been

seriously damaged, it will be no easy matter to restore the land to a fertile state. During the past year Dr. Mann and Mr. Knight have investigated the problem and a small preliminary experiment in reclamation has been started near Bárámati. The matter will be thoroughly gone into during the present year. The same question has been investigated in the Ankleshvar Táluka of the Broach District, where also the salt is due to water-logging. Here, however, the flatness of the country makes the question more difficult. Mr. Main has submitted a report about this.

CHAPTER VIII.

Entomology.

30. For the first time this year a separate printed report is being issued, embodying the work of Mr. Rámráo Kásárgode, our field entomologist. The most important discovery consists of a cheap and effective way to defeat the potato borer which annually causes such large losses to the potato growers of this Presidency. Leaflets will very shortly be issued on this subject, and on several other entomological matters where we can recommend practical measures against insect pests.

CHAPTER IX.

Mechanical Work.

31. Two new branches have recently been added to the Department—one for well-boring in the deep sandy soils of Upper Gujarát, the other to take up the question of water-lifting from rivers and wells by various mechanical means. We have as yet hardly commenced operations in either of these matters, but some of the preliminary organizing work has been done and we hope to get to work in earnest during the present year. The scope of this work has already been reported to Government, and it will be more satisfactory to defer further reference to these matters till next year, when we hope to have some results to shew.

CHAPTER X.

Conference, Exhibitions and Shows.

32. Under this heading I have to mention the Ahmedabad Conference, the Dhulia Exhibition, and the Sangamner Show. The proceedings of the Ahmedabad Conference held in November 1907 have been separately published; the suggestions made there have been summarised and orders have been issued in the matter by Government. We shall endeavour to follow the lines that have been indicated to us, and if our progress appears to be slow, it may be remembered that we are a small Department operating over a very large area, that our energies are at present much taken up in the administrative work which a rapid expansion of the Department renders inevitable, that our junior ranks are filled with recruits who have only just emerged from College, and that there has been little continuity in the upper ranks. In these matters time is on our side.

33. The Dhulia Exhibition took place in the end of April in connection with the Provincial Conference. A full account of it is printed as an appendix to the Dhulia Farm Report.

34. The Sangamner Show held in February was a much smaller affair than the Dhulia Exhibition and was organized by the Sangamner Agricultural Association. It has formed the subject of a special report.

35. The Dhulia Exhibition was of a general and comprehensive nature and cost the Department Rs. 2,440 while the Sangamner Show was a more restricted affair and cost us only Rs. 530. I am inclined to think that in future we shall get better value for our money by means of small local shows, specially adapted to the conditions of the locality in which they are held, than by more comprehensive and ambitious exhibitions.

CHAPTER XI.

The Spread of Agricultural Knowledge and the Relations of the Department with the Public.

36. I have endeavoured above to give a general account of the work which we are doing, and I think that it will be realized that the expansion of the Department from its very modest dimensions of a few years ago to its present size, and the preparations which we have in hand for further development, involve a great amount of administrative work to all concerned. Further, a perusal of the farm reports will give a good idea of the valuable and exacting scientific work which is being undertaken. I find it commonly said, however, "What is the value of all the work so long as you keep it to yourself, and the cultivators do not adopt your ideas?" I admit the force of this argument; and while the Department claims the credit for what practical results have been achieved in the past, we would gladly extend our efforts in the direction of agricultural propaganda; indeed, we must take decisive steps to do so.

37. The steps indicated appear to me to be as follows:—We must bring the work on our farms into close touch with the practical problems of the farmers, and in order that we may do this we must study the existing practice and difficulties of the farmers much more closely than we have yet been able to do. Whenever we get a satisfactory result on a farm we must make a careful estimate of its net advantage to the farmer, and consider how the adoption of our advice will fit in with the rural economy of the locality. We must train our staff in the art of demonstration, and make them realize that this side of their duty is no less important than the work of investigation. We must set our ideas in order, and to make sure what it is that we have to teach, and to what locality it is suitable. In the recent changes in the *personnel* of the Department no doubt much valuable knowledge of detail has been lost; and in looking through our departmental literature I have found very few points on which I could put my finger and say "there is a matter which we should bring to the notice of the cultivators." In our reports many experiments are said to be satisfactory, many crops to do well, many operations to be useful; but there has been little attempt to work out accurately the profit and loss account of any operation, to shew in what it differs from existing practice, and to what particular locality and circumstances it is suitable for adoption. It involves a lot of labour to take the final step, but without doing so it is impossible to thrust the matter on the notice of the cultivators, to answer their practical objections and to get them to adopt the advice offered. In saying that there has been little done in the past it must not be thought that I am carping at the past work of the Department; there has been in the past no staff available to undertake this work; there is very little staff available for it now. If we are able to make any advance in this direction it will be due to the existence of our trained and competent senior men whom we owe to Mr. Mollison's efficient *régime*. All I say is that we must set our ideas in order and get our facts precise and our details localised before we go to the cultivators with any advice; for they are a very critical audience to address on the subject of agriculture, and are not interested in generalities.

38. A series of leaflets is being prepared, embodying the useful facts that we are prepared to put before the cultivators, and every member of the agricultural staff has been asked to turn his attention to the preparation of fresh leaflets, embodying matters which may be found to offer distinct profits. The mere distribution of these leaflets will probably be of little practical use but they will serve as a basis for discussion; they can be distributed with advantage after a demonstration or lecture, while their preparation will serve to make our ideas more precise. It is commonly objected that there is no use advising the cultivators to adopt improved implements or concentrated manures because they cannot afford them; but if it can be clearly shewn to the cultivator that by the expenditure of Re. 1 he can get a profit of Rs. 2 he may be made to see that it is a profitable business to buy a rupee for 8 annas, and that he cannot afford not to do so. Again, in matters of ordinary cultivation it is often asserted that the

cultivator knows all that there is to know. It is true that he knows much. He knows, for instance, that with clean and thorough cultivation he will get a better crop than with bad cultivation; but in many places I doubt whether he realises how great a difference it makes, or that it would often pay him better to cultivate one acre well than two acres badly. Such are the matters that we have to teach; and we have much detail to learn before we shall be in a strong position to teach. To accomplish the end in view additional staff will be required, and this matter is being reported separately.

39. The establishment of Agricultural Associations offers another means towards diffusing knowledge. Such associations exist at Dhárwár, Ahmednagar and Sangamner, and we have been able to give them assistance in the past and are exerting ourselves to do so in the future. Others exist at Alibág, Jalálpur and Ránder, for which we have as yet been able to do little or nothing. A new association has just been started with much sign of promise at Bijápur, which I am just about to visit; while a movement is on foot to establish one in Poona which will, I hope, become in time the parent of many others in the Deccan. We have every wish to establish close connection with such associations as exist and to encourage the formation of others; but the powers of our limited staff prevent us from undertaking liabilities which we have no chance of performing or in localities of which we have little knowledge.

CHAPTER XII.

General.

40. It is impossible in this report to do more than indicate the principal matters that have occupied our attention during the past year. The general summaries attached as appendices to this report give more detail; and anyone requiring fuller information can refer to the reports of the different farms which have been printed separately. The Surat and Dhárwár Farm Reports, in particular, contain much valuable and interesting information. It was unfortunate that Mr. Knight was prevented by illness from writing the summaries and reports of the work for which he was responsible. Dr. Mann also was prevented by the same cause from giving his own account and opinions of the College and chemical work.

41. In conclusion, I may say that I am well satisfied with the work done by the members of the Department, and am glad to be able to state that several junior members of the Department have shewn considerable powers of initiative and originality. These are amongst the most valuable qualities that we can hope to find in our staff, and we will spare no pains to give them full play and recognition. The senior Superintendents have done good and careful work; and I would particularly mention the name of Mr. M. L. Kulkarni, Superintendent, Dhárwár Farm, who apart from the competent superintendence of his farm has carried through with much success the work connected with the popularisation of Broach cotton in the Dhárwár District, and has been a moving spirit in the local Agricultural Association.

I have the honour to be,
Sir,
Your most obedient servant,

G. F. KEATINGE,
Director of Agriculture.

SUMMARY OF EXPERIMENTAL WORK, 1907-1908.

APPENDIX A.

UNDER THE DEPUTY DIRECTOR.

Cotton.

1. The principal cottons grown during the year may be classed as under:—

Americans, Cambodias, tree cottons, indigenous cottons and hybrid cottons.

The Americans are suitable for certain parts of the Southern Marátha Country and several gave very promising results in the year under report. The best are tabulated below:—

Register number.	Name.	Ginning percentage.		Valuations.		Date of introduction.
		Ratio of lint to seed cotton.	Gain over local Dhárwár-American.	In Rs. per khandi of 784 lbs.	Percentage gain over local Dhárwár-American.	
1	2	3	4	5	6	7
43	Texas long staple	35	+21·6	260	+ 13	1907
38	King's improved	37·5	+30·3	240	+ 4	1904
34	New Orleans	34·38	+19·5	245	+ 6·5	1904
36	Truith	34·55	+20·5	240	+ 4	1904
40	Allen's hybrid	31·18	+ 8·3	250	+8·66	1906
42	Tata's Allen hybrid	29·03	+ 0·9	260	+ 13	1907
	Ordinary Dhárwár-American ...	28·78	...	230	...	...

The site occupied by the Dhárwár Farm is, however, not situated in the centre of the Dhárwár-American cotton district, and indeed this cotton does not flourish particularly well at Dhárwár. Arrangements have therefore been made to lease a piece of land near Gadag and to this place all the newly introduced Americans and American hybrids will be transferred in the coming season.

The Cambodias consisted originally of three cottons introduced from Cambodia in Indo-China, but latterly a few more cottons botanically identical with the above have been received from different parts of the world including the Philippine Islands and West Africa while buri kapas of Bengal also belongs to this class of cotton. Excellent results were obtained both at Dhárwár and Surat with these cottons. From the following tabular statement it will be seen that the ginning percentages obtained at Dhárwár are superior to those obtained at Surat, but on the other hand the highest valuations for the two best were obtained for Surat-grown cotton. With regard to the ginning percentages these cottons are naturally very high, and it is expected when they become fully acclimatized that they will shew even better figures, especially at Surat.

Dhárwár Experimental Station.

Register number.	Source or country of origin.	Yield		Ginning percentage		Value		Remarks of Messrs. Tata & Sons who kindly valued these cottons.
		in lbs. per acre.	Percentage increase or decrease over local deshi cotton.	of lint to seed cotton.	Percentage increase over local deshi cotton.	in Rs. per khandi of 784 lbs.	Percentage increase over local deshi cotton.	
1	2	3	4	5	6	7	8	9
53E	Philippine Islands ...	175	—24	36·84	+ 28	245	+6·5	Compared to No. 3 it is superior in length of staple, better in colour also.
66E	Indo-China	241	+ 4	38·00	+32·4	240	+4·3	Same as above but a bit shorter in staple.
67E	Indo-China	355	+49	37·83	+31·8	240	+4·3	Ditto.
68E	Indo-China	337	+45	38·23	+35·6	240	+4·3	Ditto.
Deshi	Dhárwár-American ...	232	...	28·78	...	230	...	

Surat Experimental Station.

Register number.	Source or country of origin.	Yield		Ginning percentage		Value		Remarks of Messrs. Tata & Sons who kindly valued these cottons.
		in lbs. per acre.	Percentage increase over local deshi cotton.	of lint to seed cotton.	Percentage increase over local deshi cotton.	in Rs. per khandi of 784 lbs.	Percentage increase over local deshi cotton.	
1	2	3	4	5	6	7	8	9
53E	Philippine Islands ...	Not available.	...	33·80	+ 3·04	260	...	Colour very good; good staple.
66E	Indo-China		...	35·20	+ 7·31	270	...	Staple a little better than above.
67E	Indo-China		...	36·20	+10·36	190	...	Very soft short staple.
68E	Indo-China		...	35·30	+ 7·62	180	...	Same as above but dull.
	West Africa		...	35·70	+ 8·84	240	...	Rough feel; good staple.
	Broach deshi		...	32·80	...	250	...	

Tree Cottons.—At all the stations—Dhárwár, Surat and Nadiád—very promising results have been obtained with these cottons. The valuations of those grown at Surat kindly made by Messrs. Tata & Sons are tabulated below. On the day when these valuations were made Deshi Surti was priced at Rs. 250 per khandi of 784 lbs.

Serial No.	Valuations of Messrs. Tata & Sons in Rs. per khandi of 784 lbs.	Remarks of Messrs. Tata & Sons.
53	325	Soft, silky, strong staple and strong fibre.
54	335	Feeling coarse but staple strong and long.
55	325	Same as No. 53.
61	335	Same as No. 54.
62	325	Same as No. 53.
64	300	Long staple, fibre strong, colour dull.
68	350	Silky, soft, very long and strong, colour good; *best of the lot.*

At Dhárwar Bourbon variety gave the best results and this variety promises to be the most suitable tree cotton for the Southern Marátha Country; it seems to be admirably suited to the medium black-red soils which are met with where the laterite formations adjoin the black cotton soil areas, and on such soils this tree cotton flourishes as a dry crop. On the other hand the pure red soils do not seem to hold sufficient moisture while the black soils appear to hold too much by forcing vegetative growth to the exclusion of reproductive developments; it is the opinion of the writer, however, that the red soils by judicious farming could be greatly improved so as to be made to retain a greater percentage of soil moisture than they do at present, and thus become suitable for Bourbon tree cotton.

On a plot of poor light red soil the following results were obtained during the past two years from the same plants the seed of which was sown in June 1906:—

Kind of soil.	Yield per plant in 1906-1907.		Yield per plant in 1907-1908.		Remarks.
	In tolas.	Ginning percentage.	In tolas.	Ginning percentage.	
(1) Medium black soil ...	21·00	26·05	42·00	28·27	In the compound near office.
(2) Red soil	3·75	25·00	6·50	28·02	In light soil on the farm plot No. 179.
(3) Sample plot as No. 2 but one special plant only.	21·00	25·50	32·10	...	Do.

Note I.—None of these cottons have received any irrigation.

Note II.—No manure was applied to any of these cottons.

Note III.—In the case of No. 2 the plants were very young in 1906-1907 and hence the yield of 3·75 tolas is not a fair figure but would have been more nearly 6·50 (the outturn obtained in 1907-1908) had the seed been sown early.

With regard to the last line of the above statement this cotton was obtained from one plant noticed among the other plants grown on the red soil plot; this plant grew very vigorously and produced very large flowers and numerous bolls and the lint was found to be of superior quality. From the appearance of the plant it is presumed to be a natural cross of which Bourbon is the female parent. The seed produced in 1906-1907 was sown in 1907 and has given rise to a great variety of plants, all of which are very vigorous and have yielded a superior class of fibre. An endeavour will be made to raise up a new strain of tree cotton from these plants in which it is hoped the quality of the fibre may be "fixed" at the high standard set by the parent plant.

At Nadiád the work has not progressed so far yet as at Dhárwár and Surat but some excellent cottons on a small scale were grown on this Station in the year under report. These consist of certain strains of Bourbon and hybrids between Bourbon and one or other of the following cottons—Texas, Abassi, Sea Island. There are in all three varieties of Bourbon and 11 hybrids in which Bourbon forms one parent.

Indigenous Cottons.—Reference has already been made to the work connected with the introduction of Broach cotton into the Southern Marátha Country. As a degenerated form of Broach cotton is grown in Northern Gujarát an attempt has been made to ascertain whether seed of the best *Ját* of this variety (*viz.*, Navsari) would maintain its high qualities when grown in Northern Gujarát. Accordingly 12,000 lbs. of Navsari seed was recently distributed in the villages of Bávla, Chaloda, Rasham and Rupawáti of the Dholka Táluka of Ahmedabad. Both Broach and Khándesh cottons have been tried on the Muvália Farm and the yields obtained were most encouraging. This is important in view of the fact that cotton is not grown in the Dohad Táluka of the Panch Mahals.

It was pointed out in paragraph 4 of last year's report that the cotton of Khándesh consisted of a mixture of some 6 varieties or types and that the variety giving the highest ginning outturn commanded the lowest price in the market but gave the greatest yield per plant. In the year under report a small area of each type was sown for comparison *inter se*. The area was not large enough to give definite information as to the relative yields per acre of each type but it was possible to obtain definite information about the ginning percentages and the relative values of each.

Khándesh Cotton Mixture.

Local name of cotton.	Scientific designation.	Ginning percentage.	Value in Rs. per khandi of 784 lbs.	Remarks by Messrs. Tata & Sons who kindly made the valuations.
1	2	3	4	5
			Rs.	
Bani	G. Indicum	23·0	225	Feel soft, class barely fine, good staple.
Jari (*a*)	G. Neglectum Veru ...	24·6	230	Feel soft, class fine but slightly shorter in staple than Neglectum Veru Kathiawarensis.
Jari (*b*)	G. Neglectum Veru Kathiawarensis.	24·0	235	Same as the last but longer in staple.
Jari (*c*)	G. Neglectum Veru Malvensis.	23·0	235	Too small for opinion but from the feel and the look may value as stated.
Varádi (*a*) ...	G. Neglectum Rosea ...	32·1	208	Feel coarse, colour dull, short staple.
Varádi (*b*) ...	G. Neglectum Rosea Cutchica.	31·9	208	The colour is not so good.

Note.—Khándesh cotton is grown over an area of 12½ million acres throughout India and therefore occupies about 70 per cent. of the total cotton area.

Messrs. Tata & Sons further remark that the first 4 samples are all good stapled cotton and in feel and style resemble "Oomras"* more than Khándesh.

It is therefore a matter for continued investigation to ascertain whether the low priced but high ginning types of Varádi are on the whole more profitable to the cultivator than the low ginning but higher valued types of bani and jari, and there is the further point to be investigated and that is whether a hybrid cotton embodying the high ginning percentages of Varádi together with the quality of jari can or cannot be obtained.

Hybrid cottons.—In paragraph 4 of last year's report my predecessor was led to make certain statements in which I do not find myself in agreement. To make the case clear I propose to quote an extract from his remarks and then submit it to a critical examination.

The following extract is taken from paragraph 4 of last year's report :—

"(*a*) *Cotton Breeding.*—Practical results have now been obtained in the production of an improved variety for the Surti-Broach tract; the three crosses numbered 1027A, 1338 and 1339 have maintained their superiority over the local kind, for the past

* Oomras is the commercial term for the cotton of Amráoti tract.

three seasons and shew now no variation . . . . . In spite of its colour Messrs. Ralli Brothers value it (*viz.*, 1027A) at 5 per cent. above Navsari cotton, which itself carries a value of 6 to 7 per cent. above that of the best cotton we can grow at our Station. In other words, the cross in question is superior to the ordinary variety *when grown under the same conditions by about 12 per cent.* It is therefore only a matter of time and the raising of the necessary amount of seed for a 10 or 12 per cent. improvement to be produced in the quality of the cotton from the Surti-Broach tract as a whole. When the cross has thus extended, the increased value of the cotton crop from this area will not be less than 40 lákhs of rupees per annum."

I am of opinion that all these remarks are entirely premature and overdrawn.

With regard to the question of value it will be seen from a reference to stage VI, column 7, in the tabular statement given below, that Messrs. Tata & Sons valued hybrid No. 1027A as equal to Navsari cotton. The Directors of the Bombay Cotton Trade Association also reported as follows upon this hybrid :—

"About the same as sample No. 5" which they described as "very nice and quite as good as Navsari. The staple is very good but it appears to be a little bit irregular."

In the extract quoted above my predecessor points out that Messrs. Ralli Brothers valued this hybrid at 5 per cent. above Navsari cotton but he does not apparently take into account the valuations of the Directors of the Bombay Cotton Trade Association nor of Messrs. Tata & Sons both of whom classed this hybrid as equal to Navsari cotton. There is no record in my office of Messrs. Ralli's valuations but a reference to that firm elicited the information that they had not kept a copy of their valuation but thought they gave it verbally to Mr. Fletcher when he paid them a visit.

With regard to the assertion that this hybrid "for the past season had shewn now no variation," it is only necessary to refer to columns 4, 5 and 6 of the tabular statement below, where it will be seen that its alleged superiority over the local cotton, as regards value, has fluctuated enormously while its ginning percentage has gradually and consistently fallen from 36·9 to 30·3 by an annual decrease of about 1½ per cent. throughout the period of the last 5 years.

This phenomenon, in respect of the ginning percentage, is not an altogether surprising one in view of the fact that Kumpta, the normal ginning percentage of which is 25 per cent., was the male parent of this hybrid.

History of Hybrid 1027A referred to in paragraph 4 of last year's report.

Stage in development.	Designation of hybrid.	Treatment.	Percentage number of plants retained after plant to plant selection and from which the cotton samples sent for valuation were taken.	Percentage of lint to seed cotton.	Percentage increase in value over deshi Surti cotton.	Messrs. Tata & Sons' remarks.	Description of seasons.
1	2	3	4	5	6	7	8
I	Cross (Kumpta × Ghoghári) obtained ...	This cross was made by Prof. Gammie on Kirkee Farm in 1901.	...	...	...	.....	.....
II	Cross numbered 1027	Sown on Kirkee Farm in 1902.	...	...	...	.....	.....
III	Cross No. 1027 Sub-division 1027 (the remaining plants were rejected). 1027 (two specially good plants).	Cross No. 1027A was sown on Chhárodi Farm in 1903 and at harvest time in the spring of 1904 it was sub-divided by Mr. Fletcher (*vide* preceding column).	2 plants...	36 9	+5 4	Much improved by crossing, in all respects resembling Navsári, suitable for 40s.	Owing to the unfavourable rainfall the variety tests at Chhárodi did not yield as well as it would otherwise have done. Two waterings were found necessary.
IV	Cross No. 1027A. (50 per cent. rejected). (50 per cent. retained).	Cross No. 1027 was sown on the Surat Farm in 1904 with the results shown in other columns.	50 per cent.	35·5	+14·6	Fibre improved both in class and staple, suitable for 44s.	The season on the whole favourable.

Stage in development.	Designation of hybrid.	Treatment.	Percentage number of plants retained after plant to plant selection and from which the cotton samples sent for valuation were taken.	Percentage of lint to seed cotton.	Percentage increase in value over deshi Surti cotton.	Messrs. Tata & Sons' remarks.	Description of seasons.
1	2	3	4	5	6	7	8
V	Cross No. 1027A. (30 per cent. rejected). (70 per cent. retained).	Cross No. 1027A was sown at Surat in 1905.	70 per cent.	34·0	+18·9	Very much improved both in colour and staple, fine silky long staple, fibre strong, suitable for 44s.	The season after giving hopes of a good monsoon in the beginning turned out even worse than last year. The total rainfall was less than half the average (40 inches) and not well distributed. Except 39 cents no rain fell after the middle of September and it was necessary to give irrigation to hybrid 3.
VI	Cross No. 1027A. 1027A (long and coarse, 44 per cent.). (24 per cent. rejected.) 1027A (long and fine, 32 per cent.).	Cross No. 1027A, long and fine, was sown at Surat in 1906.	32 per cent.	32·3	+7·5	Very nice indeed, colour and staple both have improved and is fully equal to Navsári cotton.	The monsoon burst favourably on the 9th June but the season was on the whole unfavourable. Continuous rains in July and August followed by a complete drought in September onward were the features of the season, and irrigation was given to this hybrid.
VII	Cross No. 1027A, long and fine. (50 per cent. rejected). (50 per cent. retained).	Cross No. 1027A, long and fine, was sown at Surat in 1907.	50 per cent.	30·3	+6·0	Improved in staple.	Very unfavourable season. The crop could not be sown till September and no rain fell after sowing till the crop was harvested and hence once irrigation was given.

The fluctuation in value as shewn by column 6 depends very largely on the figures stated in column 4 because the quality of the lint which determines the value would naturally depend on the rigour with which the plant to plant selection was carried out.

Of the other 2 hybrids referred to in paragraph 4 of the last year's report No. 1339 has retained its enhanced quality but its ginning outturn is the lowest of all the hybrids on the Station, a thing which might reasonably have been expected in view of the fact that both parents were Kumpta, the normal ginning percentage of which is 25 per cent., and hence this hybrid can scarcely yet be described as suitable for cultivation in the Surti-Broach tract when the deshi cotton has an average ginning percentage of 33 ; with regard to the remaining hybrid No. 1338, my predecessor divided the produce last year into "long and fine" and "long and coarse;" however, the produce of the "long and fine" sub-division produced in the year under report barely exceeds in value deshi Broach, while the produce from the "long and coarse" sub-division ranks equal 4th best on the Station and was valued at 6 per cent. above deshi Broach.

All this discussion only serves to emphasise the extreme instability of cotton hybrids. Much light has recently been thrown on the subject of plant breeding by scientific investigators in Europe, and the laws which determine the perpetuation of characters possessed by the parent in the offspring are now becoming more fully understood. The extreme importance of propagating a hybrid from one original cross and not a mixture of several similar crosses has now become fully realized, and it is now hoped to establish the work of hybridization in cotton upon a more sound foundation in the future and to secure a much greater control over the phenomena which in the past have given rise to such provoking fluctuations and valuations hitherto characteristic of this work. The breeding work upon the several cotton stations throughout the Presidency has now been remodelled on the lines indicated above and it is hoped that the work will become more and more controlable with the increase of our knowledge appertaining to the laws of inheritance in the vegetable kingdom. Apart, however, from the fluctuations to which attention has been drawn, hybrid No. 1027A has maintained for several years a superiority of not less than 6 per cent. above the local deshi cotton and in the year under report ranks equal 4th best of all the hybrids on the Station.

Generally it may be said that this year's results of the hybrids grown upon the Surat Farm are entirely satisfactory as may be gauged from the tabular statement below, and this is all the more striking in view of the very unfavourable season which prevented sowing operations till September and subsequently failed to provide a drop of rain throughout the entire growing season—a phenomenon which could not fail to prejudicially influence the quality of the fibre.

Statement showing the per-acre yields, the percentage ginning figures and the trade valuations of the more promising hybrid cottons grown upon the Surat Agricultural Station during the year 1907-1908.

Serial No.	Designation of cotton variety in cotton register.	Origin.	Area.	Yield in lbs. per acre.		Percentage of lint to seed cotton.	Tata's valuations in Rs. per khandi of 784 lbs., 1908.	Adjustment necessary before a comparison with 1907 valuation can be made with those of 1908.	Adjusted valuations of 1908 comparable with those of 1907.	Tata's valuation in Rs. per khandi of 784 lbs., 1907.	Remarks of Messrs. Tata & Sons, Cotton Merchants, Bombay.
				Seed cotton.	Lint.						
1	2	3	4	5	6	7	8	9	10	11	12
			A. G.								
1	1340, Long and Fine.	Kumpta × Kumpta prolific and re-crossed in 1904.	0 10	...	...	28½	275	...	...	...	Improved in staple and colour.
2	1339, Long and Fine.	Kumpta × Kumpta fine and re-crossed in 1904.	0 25	...	...	27 7/10	270	+15	285	280	Improved in staple.
3	1027A, Long and Coarse.	Kumpta × Ghoghári, late.	0 19	688	233	33 2/10	270	...	...	...	Improved in staple and feel.
4	Fine Broach (1st picking).*	.....	0 20	...	....	32½	265	+15	280	275	Improved in staple.
5	1027A, Long and Fine. §	Kumpta × Ghoghári, late*.	1 20	... §	...	30 3/10	265	+15	280	285	Do.
6	1338, Long and Coarse. §	Broach × Broach, a re-cross of No. 1018.	0 5	334 §	104	31 2/10	265	...	...	...	Improved in staple and colour.
7	1018 V./G. § ...	Broach × Broach ...	10 0	400 §	125	31 1/10	263	+15	278	280	Longer in staple than No. 5, equal in other respects.
†8	1018 P./G. § ...	Do. ...	6 8	595 §	185	31 2/10	263	...	...	...	Improved in staple.
9	1027 V./G. § ...	Kumpta × Ghoghári, late*.	3 0	362 §	125	34⅓	263	...	...	...	Improved in staple and colour.
10	1028 V./G. § ...	Kumpta × Ghoghári only.	3 13	653 §	188	28⅘	260	...	...	...	Do.
11	1340, Long nd Coarse. §	Kumpta × Kumpta and re-crossed.	0 20	499 §	140	28 1/10	260	...	...	...	Improved in staple.
12	1027 O./G. ...	Kumpta × Ghoghári, late.	1 18	494	175	32½	260	...	...	...	Do.
13	1058 O./G. § ...	Broach × Wagad ...	3 10	396 §	130	32⅘	259	...	...	...	Do.
14	1058 V./G. ...	Do. ...	0 30	432	138	32 1/10	259	...	...	...	Do.
15	1343 ...	Ghoghári × Kumpta ...	0 2	625	196	31⅓	257	...	...	...	Do.
16	1338, Long and Fine.§	Broach × Broach, a re-cross of 1018.	0 5	... §	...	33 7/10	255	+15	270	285	Do.
17	Fine Broach* (2nd picking).	.....	0 20	...	...	36 3/10	255	...	...	...	Do.
18	1030 O./G. ...	Ghoghári and Kumpta ...	0 13	766	263	34⅔	255	...	...	...	.....
19	1014 O./G. § ...	Broach × Kumpta, fine ...	2 0	525 §	152	28½	253	...	...	...	Improved in staple.
20	1337, Long and Coarse.	Kumpta × Ghoghári, a re-cross of 1027A.	0 4	595	188	31⅓	253	...	...	...	Improved in colour.
21	1014 V./G. ...	Broach × Kumpta, fine ...	1 4	320	97	30½	253	...	...	...	Slightly better in staple.
22	1030 O./G. ...	Ghoghári × Kumpta ...	0 20	534	194	36 2/10	253	...	...	...	
23	Ordinary Surat Broach. ‡	.....	...	550 ‡ 270	180 90	32⅘ 33	250	+15	265	265	

* This is not an artificial hybrid cotton but is the progeny of a plant which was picked out of a field of ordinary Broach cotton in the year 1904 by Mr. K. D. Kulkarni, Cotton Supervisor, and it must have been either a sport or a natural cross.

† A large quantity of seed has been distributed to selected cultivators for sowing next season (1908-1909).

‡ Ordinary Broach Cotton, Surat Experimental Station, yielded up to 550 lbs. of seed cotton per acre but the estimated yield of Broach cotton in Southern Gujarát was 270 lbs. of seed cotton per acre (*vide* final forecast published in February 1908).

Note I.—None of the plots on which these crops stood were manured except those that are marked thus §, and these received a dressing of 20 cart-loads per acre.

Note II.—No rain fell between the time of sowing and the date of harvesting, but those cottons marked * received one irrigation.

Note III.—In the case of Nos. 1, 2, 4, 5, 16 and 17 the yield per acre is not shown because plant to plant selection was made and a number of inferior plants was removed before the first picking took place.

From the tabular statement given above it will be seen that there were 21 hybrids grown at Surat last season, which were valued above deshi Broach. Of these—

one was valued at 10 per cent. above deshi Broach,
two others were valued 8 per cent. deshi Broach,
three do. 6 do. do.
and three do. 5 do. do.

etc.

At Dhárwár the most successful work has been accomplished with hybrids originally bred on the Station, while all the hybrids which, when this Station was opened, were transferred to Dhárwár from other places have proved to be of no value.

A striking feature in the work has been the consistently unfavourable results obtained when one or both parents have been either of the deshi cottons Kumpta or Dhárwár-American; on the contrary some most promising results have been obtained by crossing *inter se* newly introduced exotic varieties from America and Egypt. And even in this connection it has been found that the new cottons which have given the best results in hybridization were not those which proved to be best when grown as varieties.

The following statement gives details of the three most promising hybrids grown upon the Dhárwár Farm in the year under report :—

Serial No.	Registered number.	Origin.		Percentage of lint seed.	Value in Rs. per khandi of 784 lbs. with Dhárwár-American at Rs. 230.	Remarks of Messrs. Tata & Sons who kindly made the valuation.
		Male parent.	Female parent.			
1	2	3	4	5	6	7
69	1345 (made in 1904) .	Christopher .	Cristopher.	33·33	250	Much improved in staple and colour.
76	1356 (made in 1905) .	Culpepper ...	Cristopper.	33·80	240	Slightly inferior in staple to No. 69.
78	1361 (made in 1905) .	Abassi ...	Culpepper.	27·87	280	The best of this lot, much improved in length of staple.

No selection of fibre was made but the samples valued were typical of the whole produce.

Of the hybrids made in 1906-1907 several appear to be very promising. These include the following crosses :—

Sea Island × Bourbon.
Bourbon × Sea Island.
Abassi × Bourbon.
Abassi × Culpepper.
Abassi × Cambodia (53E).
Abassi × Cambodia (66E).
Abassi × Cambodia (67E).

It has been observed that the Egyptain Abassi strain blends very well with cottons of American origin on the Dhárwár Experimental Station.

During the year under report several new hybrids have been obtained on the Surat and Dhárwár Experimental Stations and experiments have been initiated to investigate the laws of Mendelism as applicable to cotton.

Groundnuts.

2. Much useful information has been obtained with regard to the groundnut crop on several of the agricultural stations during the course of the past season.

In the Surat Annual Report detailed information will be found dealing with the relative importance of various factors which contribute to determine the market value of any variety; some having thick shells would not pay to transport in the husk but might pay very well if husked by the producer and then disposed of in the unhusked condition. Again, the inter-varietal fluctuation in the oil percentages have been well brought out. Messrs. Ralli Brothers kindly valued a large number of samples and supplied valuable information about each variety; they pointed out that some varieties would command fancy prices in the druggist's market, amounting to Rs. 25 per cent. in excess of their commercial values for crushing purposes. Results indicate that by means of selecting the proper variety and selecting early maturing plants within that variety the cultivation of this crop will become possible on dry lands in Gujarát while the Agricultural Department has already demonstrated this fact at Dhárwár where the rainy season is a little longer than in Gujarát. It has been ascertained that so long as groundnuts command a value of one anna per pound in the local bázár for eating purposes it is unlikely that exports will increase.

Potatoes.

3. This crop was grown at Belgaum and Dhárwár and also at Dhulia and Nadiád. The principal object of the work at Dhárwár is to find out the best variety for the locality; so far Italian seed appears to be the most productive cropper. At Dhárwár it was shewn that potatoes grown in the red soils keep much better than those grown in black soils and fetch a considerably higher price when sold in the bázár. A maund of 28 lbs. of each fetched respectively Re. 1 and 12 annas in the Dhárwár Bázár on the same day. Much useful work has also been accomplished in the working out of the methods and life histories of the insects which attack this crop. The principal one is the potato moth (*Lita solaninna*). Practical preventive measures have been discovered, and it has been shewn how simple it would be for an enterprizing party to store seed according to the means recommended by this Department because there is a difference of nearly 100 per cent. in the value of seed potatoes at the sowing and harvesting times respectively, so difficult does the average cultivator find it to keep his potatoes in a sound condition for any length of time.

Tobacco.

4. Much progress has been made in the curing of this valuable product. The new curing house was used for the first time during the season under report with very encouraging results.

The value of country cured tobacco is one anna to 1½ annas per pound while the best sample cured in the new barn was valued at 5 annas per pound free of duty in Bombay, and several other samples ranged from 2 to 3 annas per pound.

The following is an extract of the letter of the Star Tobacco Co. of Bándora, Bombay, who kindly valued the samples:—

> "We have the honour to acknowledge receipt of your letter No. 271, dated the 19th instant, enclosing a parcel receipt for 20 samples of tobacco which we have examined, and find that Nos. 1, 2, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 16 and 17 are suitable for our purpose although they have not the same test as the imported tobacco. Still we believe that the samples you have sent are quite satisfactory and can easily command a good sale here. We offer 4 to 5 annas for sample No. 6 and 2 to 3 annas for the rest per pound, free delivery at Bándora station. We shall be pleased to take up the whole quantity you may have."

Wheat.

5. A beginning has been made in the survey of the wheats of this Presidency, and a large number of exotic varieties have been secured for trial in the coming rabi season. A few hybrid wheats were obtained on the Dhárwár and Dhulia Stations during the year under report.

Jowár.

6. Selection and breeding experiments were initiated on a small scale on the Dhárwár and Surat Farms, and these investigations will be extended in the coming season.

Irrigation experiments.

7. On the Surat Farm it was found that the proper time to irrigate Broach cotton was just when the bolls were beginning to set and that one good watering given at this time would increase the yield four-fold and the net profit by 66 per cent.

Similarly the yield of jowár at Dhulia was raised from 428 lbs. to 1,446 lbs. per acre as the result of one good irrigation at the critical stage. Excellent results have attended the cultivation of lucerne on the Surat Farm. A plot of land laid down to lucerne 4 years ago has given an average net profit of Rs. 74½ per acre, and it was found that watering the crop once every 15 days instead of once a month increased the net profit by Rs. 27 per acre. An interesting result of inoculating this crop with Mr. Moore's preparation was also obtained; the plot in which inoculated seed had been originally sown gave a net profit of fully 50 per cent. above that obtained on the plot wherein the seed had not been so treated.

The results obtained with regard to the irrigation of these valuable crops—cotton, jowár and lucerne—on black cotton soil are of the greatest importance as indicating what might happen if the Tápti and Narbada Rivers were turned into canals. It has long been held that it would not be practically possible to irrigate the black soils, but the truth of this contention appears doubtful in the light of the results obtained in the past season and fully reported in the annual report of the Surat Agricultural Station for 1907-1908.

Manures.

8. A large number of artificial fertilizers as well as the principal bulky manures, such as farmyard manure, night-soil and rotted cactus, were experimented upon.

Reliable results have now been obtained on the Nadiád and Surat Farms, and these are fully reported in the annual reports of each of these Stations for the current year.

The principal conclusions are :—

(1) The manures noted in the margin may be relied upon to leave a profit when judiciously applied to the crops of cotton, jowár or til, but are not likely to prove economical when applied to túr (*Cajanus indicus*), except perhaps superphosphate.

Farmyard manure.
Castor cake.
Sodium nitrate.
Saltpetre.
Superphosphate.

(2) Farmyard manure and castor cake have on the whole given the best results, but sodium nitrate and superphosphate combined have increased the yield of cotton to the same extent as farmyard manure has done, and it is possible that if these manures were applied in more judicious quantities still better results would be obtained.

(3) Nitrogenous manures have all increased the yield of jowár and left substantial profits, but unaided by other manures they are not as efficient as either castor cake or farmyard manure in this respect.

(4) The crop of túr (*Cajanus indicus*) which of course is a leguminous crop has not appreciably benefited from any of the manures except the combination of sodium nitrate with superphosphate, and it seems reasonable to suppose that it is the latter which has produced the increase in yield.

(5) Nitrogenous and potassic manures have not benefitted the túr crop.

(6) At Nadiád as the result of the average of 4 years, castor cake (600 lbs.) *plus* farmyard manure at the rate of 10 tons per acre have increased the net profit in the case of the tobacco crop by Rs. 23 and 27 per acre of the shallow and deep cultivated plots respectively.

(7) All the manures tried on tobacco have had their effects enhanced by deep cultivation.

(8) It is improbable that castor cake can be economically used alone upon the tobacco crop but requires to be supplemented by a bulky organic manure, such as farmyard manure to give its greatest efficiency.

(9) Nitre 112 lbs. per acre *plus* 10 tons of farmyard manure gave a net profit of Rs. 9 per acre in the case of the deep cultivated tobacco crop but only covered expenses in the case of the shallow cultivated plot.

(10) Continuous green manuring has been found to be most inimical to the tobacco crop in the sandy soils of the Kaira District.

(11) The general inference to be drawn from the manurial experiments upon tobacco at Nadiád is that all the commonly used fertilizers could be economically applied to this crop if the quantities were judiciously determined and a good basis of farmyard manure was first applied. Of these fertilizers castor cake appears to be the most promising, and this is very satisfactory in view of the fact that this product is largely manufactured at the Sábarmáti Mills near Ahmedabad.

(12) The long period over which bulky manures, such as night-soil, cactus manure and farmyard manure, remain effective on black soil on subsequent crops has been well demonstrated at Surat.

(13) At Dhulia it has been shewn that ten tons of farmyard manure per acre is an uneconomical dressing for dry crops and probably for irrigated wheat.

(14) Gypsum does not appear to have much effect as an indirect manure on black cotton soils.

Tillage experiments.

9. The advantage of deep ploughing for tobacco has been fully demonstrated at Nadiád, while at Surat the indications are that deep ploughing for cotton in black soils is not desirable unless the ploughing has been conducted some months before the cotton is sown so that the soil may have had time to settle again; otherwise it is apt to retain so much moisture from the early monsoon rains that the land so treated does not become accessible for tillage or sowing operations after heavy rain so soon as land not ploughed and hence the sowing season is apt to slip by while waiting for the land to dry. The cotton seed then has to be deeply drilled with the hope of getting down to the moisture which by this time has disappeared from the top layer of the soil. Now, cotton germinates with a "cap" enveloping the cotyledons which considerably impedes the young seedling finding its way above ground, and this difficulty is accentuated when the seed is sown deep. Jowár on the other hand is benefitted by ploughing the land in preparation for the seed but the work should be done well in advance of the sowing season. Earthing up the potato rows has been proved to be a specific treatment against the potato moth which lays its eggs upon exposed tubers which subsequently become infested with grubs.

Silage.

10. This has been successfully made at Nadiád and is of the greatest value in Gujarát where the cost of fodder is annually increasing while it continues to become scarcer. Silage moreover has the advantage of providing a succulent food in the hot weather. At Nadiád in the middle of September 1907 about 39,358 lbs. of green grass was put into the silo which consists of a circular stone building extending to about 8 feet below the surface level and the same height above. The grass was purchased at that time at the rate of 400 lbs. per rupee. The silo was opened in March 1908 and is now being fed to the cattle; it is estimated that about 30,000 lbs. of edible silage will be obtained.

The analyses of the ensilage recently made by the Agricultural Chemist is as under:—

Moisture	67·12	per cent.
Soluble mineral matter	1·91	
Ether extract	·71	
Soluble albuminoids	1·19	
Insoluble albuminoids	·19	
Soluble carbo-hydrates	17·53	
Woody fibre	9·59	
Insoluble matter and sand	1·76	
	100·00	
Total nitrogen	·373	
Albuminoid nitrogen	·220	
Acetic acid	·192	
Lactic acid	1·008	

"A fairly normal sample of 'sour silage' in good condition."

It will be seen that this ensilage is not only an excellent food but also a very cheap one when the high prices of fodder prevailing at the present time (June 1908) are borne in mind; the present rate for Sundia jowár fodder is 40 to 50 lbs. per rupee.

Oil Engines and Pumps.

11. The Ruston Proctor oil engine continues to give satisfaction at Nadiád and has proved to be economical when compared with the bullock *kos* except for very small areas. It moreover possesses the further advantage of causing the water which it raises to be more efficient; this is due to the fact that the action of an oil engine is continuous while that of a *kos* is very intermittent, and hence the flow through the distributing channels is maintained in a steady stream. It is estimated that on this account the same amount of water raised by the oil engine goes 33 per cent. further than an equal quantity raised by a bullock *kos*. At Surat a new design of Ruston Proctor oil engine has been fitted up upon one of the wells. It is 6-horse power and is intended for driving not only a pump but also a cotton gin, a chaff cutter and a grain grinder; in this way it is hoped to secure the maximum of efficiency from the engine. This engine can be worked with liquid fuel. The pump deserves special mention because it has been specially designed to embody the good points of the ordinary "ram" and "centrifugal" pumps without possessing the bad features of neither. The advantages which the "ram pump" has over the ordinary rotary pump, *viz.*, the force derived from the momentum of the moving column of water, is secured in this "drum" pump while the ordinary advantages of the rotary pump are not lost; in fact, the "drum" pump combines "centrifugal motion" with "positive action."

Insect Pests.

12. The Assistant Entomologist attached to my staff has made considerable progress in the investigation into the more injurious insect pests, such as the potato moth, the cotton boll worm, the sugarcane borer, white ants, etc. Very practical preventive measures have been devised in connection with the potato moth. The whole work forms the subject of a separate report.

Distribution of Seed.

13. A special feature has been made of this class of work, and 23,640 lbs. of selected Lálio cotton seed was distributed in Northern Gujarát: 12,000 lbs. of Navsari cotton seed was also distributed in Northern Gujarát, 16,000 lbs. of Navsari cotton seed was distributed in the Southern Marátha Country and 1,150 lbs. of an improved hybrid cotton was distributed in selected villages in the Surat District. A large quantity of tree cotton seed was supplied to the Imperial Cotton Specialist. The Government of the Punjab, Bengal and Madras were supplied with large consignments of cotton seed.

Groundnut seed was largely distributed in the Deccan and to a small extent in Gujarát, Khándesh and the Southern Marátha Country.

Staff.

13. My staff consisted of

- 5 Farm Superintendents.
- 2 Assistant Superintendents.
- 1 Assistant Entomologist.
- 1 Artist.
- 11 Graduate Fieldmen (including Mr. K. D. Kulkarni, Cotton Supervisor).
- 11 Non-Graduate Fieldmen (including probationary Fieldmen).
- 1 Overseer in charge of boring operations.
- 6 Clerks distributed between my own office and the various agricultural stations.

I am glad to be able to report that the members of my staff worked well and that on the whole the Graduate Fieldmen have given me satisfaction.

T. F. MAIN,
Deputy Director of Agriculture.

APPENDIX B.

Under the Second Deputy Director.

Sind Agricultural Practice.

All data hitherto obtained tends to point out that the existing cropping system practised on the better class canals is wasteful and unnecessary. This is specially the case with perennial irrigation. For example, on the Jamráo the great proportion of the land is held by owners (often non-agriculturists) who have been given much more land than they can manage. Consequently ¾ of their holding may be lying bare at one time. A system of rotation as adopted on the Mirpurkhás Farm practised on a portion of this area would probably give better results than cultivating the whole area every 3 or 4 years.

2. On inundation canals it is largely a question of available water, and this is generally only present for 3 months. Consequently a 3 or 4 years fallowing is, if not beneficial, at least excusable. But to adopt this system on a perennial canal is from an agricultural point of view indefensible.

3. From the same point of view the model canal would be one which would give an ample supply of flow water both in kharíf and rabi to all the land it commands. In the case of the Jamráo, which is designed to water annually ½ of the area (combined kharíf and rabi) commanded, the best practice would be to cultivate intensively the better areas and to leave the "kalar" portions strictly alone.

4. This question is of the greatest importance in view of the projected large perennial canals.

Egyptian Cotton.

5. The points brought into prominence are that its cultivation in alkali ground is useless, that it should be grown in rotation, that it should be planted early, and that it must receive careful treatment.

American Cotton.

6. A definite conclusion will be able to be drawn from the present season's experiments as to whether American cotton can be profitably grown on the inundation canals. So far the growth is promising.

Berseem (Egyptian Clover).

7. In 1907 seed was obtained from North Egypt from land similar in character to Lower Sind. Unfortunately, owing to failure of water, most of the seed distributed to cultivators was killed off. Sufficient was left, however, to shew that it would grow successfully in average land. The importance of this is obvious when it is remembered that berseem is regarded in Egypt as an essential crop before cotton. It is also looked on as the absolute test of the quality of the land. Its extended adoption in Sind where water is available will undoubtedly be a great advance on existing conditions.

Miscellaneous.

8. Of the other crops grown on the Farm the local jowári and bájri seem to be as good as any. Among the wheats "Bubak" and "Nundero" are the best varieties, and will be distributed the following season. "Kháno" is at present not much cultivated; it has been found to do well on "kalarish" soil and is fairly "rust" resisting. There is little market for it, but a valuation is being obtained from Italy.

9. "Túr" and some other of the pulses grown are likely to be useful.

Implements and Water-measuring.

10. A modification of the native Egyptian wooden plough and also a wooden scraper for levelling land have been made and are being widely distributed. They are both much needed in Sind. The principle of the Archimidean screw has been applied to water-lifts where the height to be raised is low, and has been found to be much more efficient than any existing animal power lift.

11. Water applied to crops has been measured and several interesting results obtained. They have to be confirmed.

Alkali Experiments.

12. About 5 acres of bad "kalar" land on the farm were washed and drained. The results are very satisfactory. This land now shews a very marked difference, the crops growing on it are strong and luxuriant. It seems safe to suppose therefore that any "kalar" land of similar nature can be reclaimed where there is a sufficient supply of water and a drainage outlet.

Proposed new Experiment Stations.

13. The following new Stations are contemplated:—

(1) Dáur in Nasarat Táluka.

(2) Sewán or Lárkána.

14. Land has been reserved at Dáur which would make a suitable site for a demonstration farm. It is the centre of a newly colonized area, formed by extending the old Dád and Nasarat Canals. Only kharíf and a little "bosi" rabi cultivation is practised. American cotton will probably succeed well in this area.

15. There is great need of a station in Lárkána District in order to collect, cultivate and distribute the several fine varities of rice grown there.

16. With these extra centres the Agricultural Department would be in a position to carry out a much wider propaganda and be able generally to exercise a much larger influence than is at present possible.

G. HENDERSON,
Deputy Director of Agriculture, Sind.

APPENDIX C.

Under the Professor of Agriculture.

1. The experiments summarized below were planned by Mr. Fletcher from rough notes left by the Professor of Agriculture before going on leave. Mr. Knight resumed charge in September.

2. The following Stations and Sub-stations were under the direction of the Professor of Agriculture during the year of report:—

No.	Name of Station.	Height above sea level.	Date when established.	Area of Station.	Kind of soil.	Rainfall.
1	2	3	4	5	6	7
		Feet.		Acres.		Inches.
1	Agricultural College (Poona District) ...	1,850	1906	144	Medium black ...	32
2	Mánjri ...	1,850	1894	62	Do. ...	21
3	Lonávla ...	2,039	1904	25	Light ...	180
4	Bárámati ...	1,774	1906	5	Medium black ...	22
5	Nagar ...	...	1907	20	Do. ...	20

3. Experimental work was in the main a continuation of that of the previous year together with some new work at Mánjri with cane-crushing and gul manufacture, and also dry farming experiments at Nagar. The work during the year included:—

(1) at the College Farm, observation and selection of varieties of wheat, jowár, túr, cotton, chillies;

(2) at Mánjri, experiments with cakes and artificial manures and the best quantities to use with farmyard manure for sugarcane: quantity of water necessary and best periods for its application: testing the power mill and comparing it with the local mill: trying a new mould for gul: experiments were also made with Broach cotton under irrigation and trial of wheat varieties found successful on the Poona Farm;

(3) at Lonávla, investigation into the ráb question;

(4) at Bárámati, only ratoon Broach cotton was tried under irrigation: in March a new area was leased to demonstrate best manuring and irrigation of sugarcane: also experiments in reclaiming salt land have been started in conjunction with the Agricultural Chemist;

(5) at Nagar, fourteen wheat varieties and crosses which have proved successful after continuous trial and acclimatization at the Poona Farm were sown in small plots at Ráhuri and Sangamner in the Ahmednagar District to test their suitability in the wheat growing tracts: dry farming experiments were taken up at Ráhuri from last April;

(6) miscellaneous work.

Agricultural College Farm.

4. Besides plots for students and demonstrations minute notes were made of variations in the varieties of jowár, wheat, cotton, túr and chillies. The jowárs remained pure and so also did the wheat except in one case. In Poptia (Nadiád) some plants had velvety spikes; the seeds from individual plants will be grown in the coming year. The cottons in the *Obtusifolium* groups changed slowly, especially those from other provinces.

Túrs were a mass of crosses ; seeds from individual plants will be sown next year.

Chillies also changed. One plant gave 3 varieties ; whether this is a case of atavism or simple mutation will be tested in the coming year.

5. *Sugarcane at Mánjri.*—The following artificial manures were tried (either alone or in combination) in addition to farmyard manure and cake as a basis, *viz.*, sulphate of ammonia, crude nitre, sulphate of potash. In each case sulphate of ammonia gave the best result as to yield of cane and net profit. This manure seems to do better when added alone to cake and farmyard manure than when potash is also added. Crude nitre gave a large yield, but as it costs more than the sulphate of ammonia it cannot be recommended in preference to the latter. Sulphate of potash was found to have no value when applied with such heavy dressings of cake and farmyard manure. Trials were also made of the following concentrated manures, *viz.*, safflower cake, castor cake, fish manure in addition to farmyard manure. The best results were obtained when 1,500 to 2,000 lbs. safflower cake, 3,000 lbs. castor cake and 1,000 lbs. fish manure was applied per acre. Larger dressings in each case gave less profit.

Effect of manures on the quality of Gul was also studied with regard to the hardness, granulation and crystalline character of the gul. It was found that undoubted effects exist, *e. g.*, safflower cake invariably gave a fine crystalline character, while sulphate of ammonia always gave poor colour but was otherwise good. More definite work is necessary, as pointed out in the annual report, to clear this subject.

Irrigation.—The results are not quite conclusive, but it is evident from perusal of the report that frequent small waterings are preferable to heavy waterings at longer intervals.

The Power Crusher.—The Power Mill was worked throughout the last sugar-crushing season, and as will be seen from the Mánjri Report for 1907-1908 the working of the crusher compared favourably with the bullock mills. It was estimated that a saving of over 3 rupees a day would be effected by the Power Mill as compared with the bullock mill.

A new Block Mould for Gul was tried. This was found to improve the quality of the gul by letting the treacle drain thoroughly. Cultivators who visited the Farm during crushing operations appreciated its value.

An attempt was made to utilise the waste scum from the boilings by mixing it with fine megass so as to form a molassine meal. Exact data on this point will be given by the Agricultural Chemist.

Broach Cotton.—This year again a paying crop was obtained by irrigation though the yield was somewhat lower than in former years.

Wheat.—Of the 14 varieties tried, red deshi of Oudh, a soft red variety, and safed of Amritsar, a soft white variety, gave good outturn. The following three varieties did well, *viz.*, Paman of Shirsi, Potia of Nadiád and a cross of Nágpur and Muzáffarnagar.

6. *Lonávla Rice Experiments.*—These were intended to solve the question—"to what is the beneficial effect of ráb due to?"—and if possible to find a substitute. The season was very unfavourable, some of the seedlings being washed away. Only general conclusions can therefore be drawn. These tend to shew that the heating of the earth is the chief cause of the good results from rábing. As substitutes cowdung cake and safflower are most promising.

7. *Báramati.*—Only a small area of Ratooned Broach cotton was grown under irrigation. The bed and ridge system of growing was tested, but the land was unsuitable and the results not reliable ; from this year's figures it would appear that the bed system is the most profitable. Land has been acquired for demonstrating results obtained at Mánjri with sugarcane and also to investigate the salt land problem.

8. *Nagar.—Wheat.*—Here the ultimate object was to popularize the wheats found successful at Poona and Mánjri. The varieties that did best were safed of Amritsar, hybrid Nágpur and Muzáffarnagar and Paman of Shirsi, while red deshi of Oudh also did well. This is identical with what was found at Poona Farm and at Mánjri.

9. *Miscellaneous Work.*—Two Agricultural Shows were held during the year—one at Mhaswad (in connection with the Nágoba's fair) in the Sátára District and the other at Sangamner in Nagar District. The former was principally a Cattle Fair in which Khillári cattle were a prominent feature. Two representatives of the Department—Messrs. Pátil and Dándekar—attended the fair and assisted in judging, etc.

The Sangamner Agricultural Show was the most successful of the Nagar District Shows in point of coming into touch with the cultivators. It was held under the auspices of the Sangamner Agricultural Association. The Department had a separate stall in which were exhibited the principal crops and all the improved implements. Lectures and demonstrations were given by Dr. Mann, Professor Knight, Messrs. Kelkar, Dixon and Pátil.

The lectures, being framed and delivered in simple language, were much appreciated, and free discussions with the cultivators followed.

A demonstration of the advantages and working of the Arlington plough by Mr. Pátil was keenly watched. As one of the Overseers of the Department (Mr. Deshmukh) had already

spent some time in demonstrating the working of this plough in the several tálukás the people were prepared with important questions and difficulties to be solved.

One tangible result of the Nagar Show is the introduction of Párner wheat into the other tálukás of the district.

10. Many of the subordinates being new men, just out from College, were given a practical training at the various Stations, and it is hoped that most of them will soon be very valuable members of the Department.

11. The Civil Dairy at Kirkee, established in 1890, continued in charge of Mr. Knight.

The principal objects of the Dairy are:—

(1) to afford instructions for the students of the College of Agriculture;

(2) to serve as a model dairy to the public;

(3) to give opportunity for experiments in feeding and dairying;

(4) to improve dairy breeds;

(5) to supply pure milk to the invalids and children of Poona;

(6) to allow owners of milch cattle the free services of good bulls.

12. Through care in securing a pure water-supply and other precautions the health of the cattle has been excellent this year. The Dairy has been free from any contagious diseases though rinderpest is prevalent in the district. Some of the buffaloes which had aborted last year have been dry for 18 months, thus causing some loss in the present year.

The cattle consist of the following breeds:—

Cows—Aden, Sindhi and Gir.

Buffaloes—Jaffrabadi, Delhi, Kaira or Surti, and Varadi or Deccani.

13. The total number of cows was 46, buffaloes 48. Last year the strength of the whole herd was 160, and this year it was 212 or an increase of 52. The average yearly yield per cow was 1,844 lbs. and per buffalo 1,886 lbs.

14. The daily yield of the milk of each animal continues to be carefully recorded. This record is mainly intended as a guide for breeding purposes, and it is in this direction that most progress has been made. The Sindhi cows have been bred continuously for 12 years, and we now have 30 farm bred heifers and cows. Pitambari (3,337 lbs. average for nine years) and Bulakhi a four-year old which has not been dry a single day since her first calf. 2 years and 3 months ago (3,473 lbs. average for 2¼ years) stand first. Mohan a farm bred heifer which gave her first calf in March over a year ago is still in milk and promises to make a heavy milker.

The Dairy is necessarily worked to some extent on experimental lines, and economy has at times to be sacrificed in the interests of investigation and instruction.

15. Fodder for the Dairy cattle was grown on some land measuring 16½ acres, rented from Mr. Wadia. Various jowárs and millets were grown, as well as sorgham and maize. Hay and fodder was also purchased from the Poona and College Farms. The Poona Farm has now been taken over by the Dairy.

16. No feeding experiments were carried out this year.

W. ROBERTS,
for Professor of Agriculture.

APPENDIX D.

Under the Economic Botanist.

The Ganeshkhind Station.

1. The Ganeshkhind Botanical Garden was established in 1873, abandoned in 1885 and re-established on 1st October 1904. Its area is 80 acres.

2. Excess of rain fell in July and August with the result that some plants, especially Cearas, suffered from stagnation of water.

3. The soil towards the river on the north is composed of a great depth of reddish alluvial loam. Three of the plots to the southward are of inferior murum soil. For the purposes of botanical teaching a large number of specimen plants were introduced into plots Nos. 7 and 8 some years ago. Those which are intolerant of drought or require more attention have been transferred to more suitable positions.

4. *Ceara Rubber.*—The height has decreased considerably in all trees and this is due to the dying of the tops during the heavy rain. We have come to the conclusion that there is no certainty that all the seed sown *in situ* will germinate quickly, even when filed, many remaining dormant till another season.

Interculture of Bourbon cotton among the rubber is undertaken to ascertain what income will be supplied by the cotton as a subordinate crop to Ceara.

5. Last year's observations on the remaining three rubber plants are confirmed.

6. *Ficus elastica.*—Attention is paid to the propagation of this from the plant which was reported on so favourably last year.

7. *Jute.*—Two years' experience shows that the cultivation of this can be conducted under the control of irrigation in this part of the country and the fibre produced is of the same grade as is supplied to the trade on the Bengal side.

8. *Hibiscus ficulneus fibre* is not very favourably reported on by the Imperial Institute, London, except as regards its length and lustre.

9. *Sisal.*—Last year's observations are confirmed.

10. *Cotton.*—Special investigations on the Botany of the cotton plant have been continued and an attempt was made to estimate the average yield per plant of every variety grown. The plots of American cotton were maintained. Soft Peruvian, Bourbon of Bassein, and Spence cotton, are considered the best with respect to market valuations received from Messrs. Tata and Sons to whom we are greatly indebted for advice and information promptly and courteously given.

11. *Camphor.*—A quantity of seed obtained from Japan have produced plants sufficient to form a long hedge.

12. *Yams.*—The cultivation of these are now transferred to Bassein on account of the unsuitability of soil and climatic conditions in the Deccan.

13. *Silo.*—56,000 lbs. of coarse grass were placed in pits and furnished 20,000 lbs. of ensilage when the pits were opened in April.

14. *Oranges and Lemons.*—The land under these was ploughed twice lengthways and crosswise and also dug in parts. The *Kunda* grass is now almost brought under control. Citron Turang, Lemon, Shaharampur, Mahálung of Poona have fruited during the year. We hope that many of the varieties will fruit during the coming year.

15. *Pomegranates.*—The area under these was also tilled and cleared and the plants are responding to the treatment by flowering freely at the present time. The plants were also dressed with ash manure.

16. A small plantation of different varieties of Guava was also started this year.

17. A number of plants new to Poona were introduced. A considerable improvement in the ornamental portion of the garden was undertaken and attention is being paid to arboricultural operations. Shade trees were supplied for planting along the public roads of the cantonment and the Agriculture College Avenue.

The Bassein Gardens.

18. The Bassein Botanical Gardens and the experimental station (area 90 acres) were established in February 1906.

19. The soil is a sandy alluvial loam similar to that of the Bágáyat land, which forms the fertile belt along the coast in this district. The land lying to the north of the Bunder road had been laid out in rice fields by the late lease-holder Major Littlewood. As this is low-lying and flooded during the rains, it has been plotted out for experiments with rice in the kharif and suitable crops in the rabi season. During this and the ensuing year, the rice fields are cultivated strictly according to the methods of the surrounding cultivators in order to obtain a thorough knowledge of local methods. The land lying to the south of the Bunder road which was the chief residential port during the Portuguese possession is encumbered with ruined buildings which are overgrown with trees, shrubs and weeds. The traces of old roads, streets and alleys are being relaid with only a few alterations, so that the original ground plan is preserved. The work of clearing out this rank vegetation has been continuous and this land when properly arranged in the near future ought to become one of the most picturesque Botanical Gardens in India. At the special request of Mr. Cousens, the Archæologist, a small area has been left in its original condition, and the officers of the local Public Works Department under his instructions are undertaking the preservation of the more important buildings.

The old gardens belonging to the various monasteries and churches are being cultivated with crops which may ultimately be usefully taken up by the cultivators in the vicinity.

20. The rainfall was above the average but was badly distributed. For water-supply we are dependent on a number of wells scattered throughout the Fort. It is unwise to add to the depth of these owing to the danger of striking salt water. Many neighbouring cultivators have found to their cost the risk incurred by digging their wells and tanks too deep. The water of each well has been tested by the Agricultural Chemist and so far only two have been pronounced as unfit for use.

21. *Experiments.*—The garden crops cultivated by the people of Bassein are grown well and our object is to introduce some new crops which will ultimately assist them to gain a larger profit than they obtain at present. Experiments on minor crops, such as groundnut, lucerne and lemon grass have been carried out with this intention in view; and coffee, rubber, cocoa and such like other products are being experimented with the idea of introducing additional means of profit to the cultivators. Mr. Joshi, the Curator of the Bassein Gardens, is also interesting himself in the development of the backward tracts lying on or near the hills. Here the fields are usually only in use during the monsoon and he thinks it would add greatly to the prosperity of the people if arrangements could be devised for the cultivation of rabi crops.

22. *Rubber.*—The ceara rubber trees suffered by the storms of the 3rd of June and by the accumulation of water during the heavy rainfall of the monsoon. The stems of trees will be large enough to tap during next season.

Para.—This tree possesses the advantage of being able to resist the bad effects of water-logging. The growth of the plants is slow but they appear to be making good progress. It is proposed to put a plot under the control of irrigation to see whether or not a continual supply of water will hasten their growth.

Castilloa elastica.—This is a shade-loving tree which will not grow where water stagnates. Plants have been put out in the open and under shade to find out which condition suits them best.

Cryptostegia grandiflora.—This grows rampant but we find that to obtain the necessary thickness of stem the plants must not be allowed to climb too high.

23. *Bourbon Cotton.*—Of the perennial cottons the Bourbon variety alone has given promising results and it has produced an average of ½ lb. of clean cotton per plant during the first year. Seed was sown in a half acre plot on the 26th April. These flowered towards the end of September. The picking of the cotton commenced on the 27th November and the harvest closed in the first week of April 1908. The total outturn was 305 lbs. of seed cotton which would give approximately 200 lbs. of clean cotton per acre. Another ¼ acre plot was tried in black soil. These flowered on 2nd November and harvest commenced on 2nd February. The yield was about 190 lbs. of seed cotton, which works out to 250 lbs. of clean cotton per acre. The yield per plant is about 1 lb. of seed cotton. Messrs. Tata and Sons of Bombay reported as follows on the samples of clean cotton sent to them:—

Class.—Superfine.
Staple.—Long and strong.
Spinning quality.—Will spin 40 S. 44 S.
Price per Kandy of 784 lbs.—Rs. 300.

Bassein garden seem to have improved this cotton and given it a superiority in point of colour and staple over its brother reared in Ganesh Khind Botanical Gardens.

Some landholders in the Thána District have been so impressed with the promise of success in this cotton that they have spontaneously sown it on their own lands. It is true that the earlier experiments with Bourbon Cotton in Thána District uniformly resulted in failure which may have arisen from the neglect to give the plant the annual pruning it requires to produce successive full crops. The climate of the Konkan has proved unsuitable for the cultivation of other American, Egyptian and Indian varieties.

24. *Cassava.*—Forty-two varieties of this all suffered severely during the heavy rain and consequent excess of water in the soil. Cuttings were, however, saved and it remains to be seen whether good eatable roots can be obtained from the plants put out at the beginning of the rain on higher lying waste ground.

25. *Groundnut.*—There is a general belief that groundnuts will not succeed in the Konkan. Seeds were put out in the plantain grove. The yield was fairly satisfactory. The plants served the purpose of keeping down weeds and the cultivators who watched the experiments were pleased to see that groundnuts would thrive in Bassein.

26. *Cabbage.*—The cultivation of this vegetable is usual in Bassein during cold weather and experiments are initiated to ascertain if it can be possibly grown all the year round. Further experience is required before we can arrive at a decisive conclusion, but the results appear to prove that the local practice is correct.

27. *Lemon Grass.*—An area of nearly one-third of an acre was put out in July and towards the end of the year a customer was ready to buy our produce at the rate of 30 lbs. a rupee. After deducting expenses the plot realized Rs. 8 a month profit which works out at the rate of 288 rupees an acre per annum.

28. *Asclepias semilunata.*—This plant is a native of the lake shores of Africa when it is known as '*Kifumba.*' Its fibre has been favourably reported on in the London market. It thrives well in the climate of Bassein and produces seeds freely. Packets of these have been distributed to the chief Botanical Gardens, so that the capabilities of the plant can be tested under a variety of conditions.

29. *Agaves.*—The prospects of the successful cultivations of these are discouraging. The heavy rainfall during the monsoon and the drought of the cold and hot weather being unsuitable.

30. *Jute.*—The prospects of jute are decidedly unfavourable and it seems scarcely worthwhile to continue the experiments.

31. *Rice and Millets.*—Fifty-two varieties of rice and 28 of millets were grown for Botanical purposes. Few of the millets can stand the climate; so their culture has been discontinued.

32. *Beans and Gourds.*—Exotic beans did not thrive and few of the gourds did well. Of the latter a fine variety of the Bottle Gourd is cultivated very extensively in Bassein.

33. *Fruit and Economic Plants.*—Vines, pomegranates, sapetas, pumalos, oranges, limes, coffee, nutmeg, cocoa, cinnamon, camphor, &c., are under trial. It is impossible to say yet what the ultimate results may be.

34. *Garden Plants.*—A large variety of the Garden plants usually grown in India is being added to continually. An experiment in selection with Zinnia goes to prove that this does not degenerate to any serious degree.

35. *Visitors.*—A number of visitors have taken great interest in the operations of the station and many of the neighbouring cultivators closely follow the progress of introduced crops.

G. A. GAMMIE,
Economic Botanist.

APPENDIX E.

Under the Agricultural Chemist.

The work during the year under review has all been carried out in the temporary laboratory, which was furnished and fitted by Mr. Meggitt in the previous year.

2. The Agricultural Chemist was better supplied with chemicals and apparatus than in the previous year and consequently the work is developing rapidly. At the same time the accommodation in the analytical laboratory is very limited and the completion of the new Chemical laboratories is urgently desired.

3. Most of the samples received were sent by the Presidency Farms and by the Deputy Director of Agriculture. As will be seen by comparison with last year's report, the number of samples analysed in the laboratory shows a large increase over the number received in the previous year.

Name of Sample.	Year. 1906-07.	Year. 1907-08.
Soils	67	101
Manures	43	105
Food stuffs	17	41
Waters	22	80
Gul	32	34
Gul skimming	...	40
Cane Juices	...	2
Oil-seeds	47	98
Whole milk (cows and buffaloes) ...	110	513
Separated milk	123	153
Cream	123	1
Butter	2	2
Miscellaneous	10	22
Total ...	596	1,192

An important feature of the year's analytical work was the number of samples received from private sources. In this connection the following samples were reported upon :—

15 Samples of soils from cultivators.
12 Do. manures from cultivators and merchants.
11 Food stuffs.
8 Waters.

4. These figures show that the College is beginning to appeal to that class of people for whose benefit it is intended.

All the above samples were analysed and reports duly furnished but the following few remarks may be of interest.

5. *Soils.*—Most of the samples received were from Government Farms. The majority were "Alkali" or "Usar" soils.

Some samples of soils were received from the Sewage Farm of the Ahmedabad Municipality. Certain of these soils had been treated with sewage for varying lengths of time and the others had received no sewage at all. It was perfectly obvious from analyses made that the land had not been damaged by the application of the sewage, and therefore that the land, which was a light sandy loam was suitable for a sewage farm. The Municipality was advised that the land was quite able to bear the application of raw sewage in quantities not exceeding those which it has been the custom to apply to it. For this reason they were told that it was not necessary for them to put up a septic tank installation.

6. The ordinary samples of soil received and reported upon do not call for much remark. It is pleasing to note that a number of samples of soil were received from Mr. Appajawander of Dhárwár, who asked for some practical advice concerning them. His soils were analysed and detailed answers sent to his questions. He was given advice as to manurial treatment. He wished to know why a particular subsoil was adaptable to pottery making and if it could be used to make the finer classes of pottery. He was informed that this property was connected with the presence of a larger amount of real kaolin like clay than is found in the other alluvial soils in the neighbourhood. At the same time he was told that the subsoil in question was not suitable for the finer classes of pottery because it required a still larger amount of China clay and because the presence of iron oxide and other materials would prevent the formation of a colourless glaze.

7. Another point raised was the difficulty of ripening cotton on a particular soil.

On analysis the soil seemed equally rich with other similar soils in which cotton ripens well. It was found, however, that the kankar in this particular soil was in a fine state of division, while in the other soils it was present as lumps. It was therefore suggested that when this particular land containing kankar in fine state of division, dries after rain it becomes so close in texture and so hard as to seriously injure the cotton roots.

8. In the case of some black soils from Surat the amount of organic matter was determined in a number of samples by the wet combustion method. Determinations of the humus present by Grandeon's method were also made. The results are of interest inasmuch as they show no definite relation to one another of the figures obtained by the two methods.

Number of soil.	Per cent. Organic matter Company's method.	Per cent. Humus (Grandeons).
1	1·05	1·55
2	1·72	1·55
3	1·26	1·50
4	1·09	1·70
5	1·04	1·70
6	1·02	1·45
7	·98	1·55
8	1·28	1·15
9	·92	1·25
10	·90	1·97

9. With regard to Alkali soils large numbers were analysed.

A number were received from Sindh and were all found to contain sodium bicarbonate. The amount of sodium chloride in some cases was very high.

Some scrapings from the surface soil in Athwa area of the Surat Farm were received. This surface soil has been irrigated with well-water and is very rich in salts. The tilth of part of this area is very bad indeed. The following is an analysis of these scrapings:—

	Per cent.
Calcium Carbonate	·117
Calcium Nitrate	·546
Magnesium Sulphate	·144
Magnesium Chloride	·181
Potassium Nitrate	·030
Sodium Nitrate	2·274
Sodium Chloride	1·188
	5·488

As will be seen it is peculiarly rich in nitrates and the amount of sodium chloride is also very high. The presence of these salts would account for the bad tilth.

9. *Waters.*—Seventy-three samples of well-waters were received and seven canal irrigation waters. Most of the samples call for no special remark.

One of the well-waters, however, was used for drinking purposes. From its analysis it should be an excellent drinking and irrigation water.

Certain well-waters from Surat were excessively high in sodium chloride, and sodium carbonate; one of them containing over 200 parts per 1,00,000 of sodium chloride.

Some samples of well-water which are used for irrigation were received from Ahmedabad. The cultivators have found that this particular well-water rendered the land less capable of growing good crops. On analysis the waters were found to be rich in salt, and this would account for the bad effect of the water.

10. *Feeding Stuffs.*—Some forty-one samples were received. They were chiefly oil-cakes, grasses and silage and were mainly from the Dairy Farm.

Safflower cake.—The samples received contained about 40 per cent. albuminoids and one contained 19 per cent. of oil. They were very good food stuffs and with one exception which contained a rather high proportion of sand were very clean samples.

Cotton Seeds.—Two samples were received from the Military Authorities of Aden. One was an Egyptian cotton seed and the other an Indian one.

The analysis showed the feeding value of the Egyptian seed to be at least 25 per cent. higher than that of the Indian seed. The former contained 25 per cent. of oil and the latter 17 per cent. A great point in favour of the Egyptian seed was its freedom from cotton fibre, while the Indian seed still had much cotton adhering to it.

Bran.—Several samples were received from the Military Authorities. Only one calls for comment, as it had been rejected by the Military Authorities and a sample was sent here for examination. The sample did not contain either excessive husk or straw but it was slightly sour and musty and this would be sufficient to condemn it. An acid determination showed it to contain volatile acid equal to acetic acid, ·048 per cent.

Rice Bran.—The sample received was, we were informed, obtained by pounding rice after removing husk. The analysis showed it to be an excellent fodder material. It contained upwards of 13 per cent. albuminoids and 16 per cent. of fat.

Swadeshi Cocoa.—Two samples were received for examination. The particular brands are now on sale. The analysis gave the following results:—

	I Swadeshi Cocoa by Joglekar & Co.	II Swadeshi Cocoa unmarked.
Moisture	5·46	3·66
Oil, &c.	1·02	43·87
Albuminoids	10·19	9·38
Soluble carbohydrates, including starch	79·53	36·40
Woody fibre	0·60	2·95
* Ash	3·20	3·74
	100·00	100·00
* Containing sand	0·16	0·78

Sample No. I was composed of ground seeds of one of the pulse or dhals. It contained no true Cocoa whatever. At the same time it was very clean and attractive and contained no poisonous or other alkaloids. It would probably form a pleasant and nutritious drink.

The second sample was also free from injurious constituents, but it contained a large proportion of oil, which is always an objectionable feature in such a substance It had a sharp astringent taste but was not unpleasant. This sample also contained no true Cocoa whatever.

Tapioca root.—As a food, the sample received compares well with other foods as shown in the following table:—

	Tapioca root.	Sweet potato edible part only.	Whole wheat-flour.
Moisture	6·88	6·00	11·40
Fat	1·57	2·12	1·90
Soluble Carbohydrates	80·44	79·16	71·00
Albuminoids	8·13	5·46	13·80
Woody fibre	1·79	3·93	0·90
Ash	1·19	3·33	1·00
Total ...	100·00	100·00	100·00

The analysis shows it to be slightly better than sweet potato dried to the same extent, but it is not equal to wheat.

Oil-seeds.—These comprised Castor-seed, Til and groundnut. In each case varieties were compared with regard to the amount of oil they contained.

Castor seed.—Little variation was shown between different varieties.

Til.—Many varieties were examined. In the case of one series the following general results were obtained:—

Black tils	50·53 per cent. oil.
White „	55·5—58 „
Red „	54—55 „

Groundnut.—A large number of varieties were analysed and the results showed the amount of oil to vary from 40—51 per cent. The Pondichery groundnuts generally appeared to be high in oil, but on the whole there were no marked differences in the amounts of oil in different varieties.

Some groundnuts were received, some of which had been grown on irrigated and some on unirrigated land. Irrigation showed no constant differences in the amount of oil contained in the seeds grown on the different plots.

Manures.—Upwards of 100 manures were received in all. They included all the various mineral manures such as superphosphate, basic slag, bone meal, nitrates of potassium and sodium, sulphate of ammonia murcate and sulphate of potash, calcium nitrate, calcium cyanamide, ashes, &c.

A large variety of organic manures was also received such as farm yard manure sheep dung, poudrette, town sweepings, tank, mud, mhowra, refuse; nim leaves, dried blood, fish manure, castor-cake, mhowra-cake, safflower-cake, cotton seed, nim-cake, karanja cake, etc.

The following points are worthy of mention:—

Calcium cyanamide.—Several samples were received and the amount of nitrogen varied from 10—13 5 per cent.

Calcium Nitrate.—These samples contained 11—11·8 per cent. of nitrogen and one contained an excess of lime.

Basic Slag.—The samples received were generally very poor as basic slags go. One sample contained iron chippings and iron filings.

Ammonium Sulphate, Sodium Nitrate and *Potassium Nitrate.*—Samples of each of these were received which contained 50—60 per cent. of matter insoluble in water, whereas each of these manures should be completely soluble in water.

The organic manures are summarised for convenience—

	Per cent. Nitrogen.
Fish manures	5·93
Dried blood	10
Nim leaves	2·2
Nim cake	6·0
Poudrette	·40
Safflower cake	2·65—7·6
Castor cake	4—5
Coccanut cake	3·84
Mhowra	2·6

Safflower cake.—One sample as shown above contained only 2·65 per cent. of nitrogen and thus was a very poor cake.

Castor cake.—One sample contained mhowra seed and was poor as castor-cakes go.

12. *Dairy produce.*—The work mentioned in last year's report has been continued on practically the same lines. Daily samples of milk and separated milk, with a few samples of butter have been received from the Civil Dairy throughout the year and analysed.

Besides this, samples of whole milk are taken every Thursday for analysis and the data so obtained are collected for Mr. Meggitt, the late Agricultural Chemist, with a view to comparing the composition of Indian cow and buffalo milk with that of English cow's milk.

13. *Sugarcane.*—The analysis of the sugarcane grown at Mánjri Farm has been continued on the same line as last year. The results obtained are too bulky for this report and will appear subsequently in a separate paper.

14. *Miscellaneous work.*

Red gum exuded by trees in Sindh.—The sample received appeared to be of no use as a gum though it may possess medicinal properties.

Value of formalin as a fruit preservative.—The Agricultural Chemist was asked to test the value of formalin as preservative for fruit. Three distinct and careful tests were made with plantains, apples, guavas, grapes and figs. In each case duplicate tests were made with each fruit except apples. The fruits were steeped in weak formalin and in each case duplicate untreated fruit were also taken. Except in the case of apples the formalin was of no use in preventing the fruit from going bad and thus the results were disappointing.

15. *Lines of special work.*—These may be divided as under:—

I.—Alkali land investigations in the Nira Canal District.

II.—Investigations in connection with the sugarcane experiments at Mánjri.

III.—Rúb experiments at Lonávla. This work is being undertaken in co-operation with the Professor of Agriculture.

IV.—Drainage of *black* cotton soil at Surat.

On the *bhatta lands* near Surat.—Garden cultivation is practised with great success. It was tried on the black cotton soil on the Surat Experimental Farm, but was found to fail. It was thought that its failure might be due to bad drainage.

Experiments on draining the lands are now in progress.

Reports on some or all of the above pieces of work will probably be published shortly.

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for Agricultural Chemist,
Bombay, Kirkee.

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Annual Reports.

Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1907-08.

No. 12075.

REVENUE DEPARTMENT.

Bombay Castle, 26th November 1908.

Letter from the Director of Agriculture, No. A.—5822, dated 29th September 1908—Submitting the Annual Report of the Department of Agriculture, Bombay Presidency, for the year 1907-08.

Letter* from the Director of Agriculture, No. A.—5829, dated 29th September 1908.

Letter* from the Director of Agriculture, No. A.—6567, dated 31st October 1908.

RESOLUTION.—The Director's Report with its appendices constitutes a record of strenuous and useful work, notwithstanding that the Department was grievously hampered by constant changes in the personnel involving, as the Director points out, injurious breaches in continuity of work and the loss of much valuable detailed knowledge. It is of the utmost importance that the permanence of the personnel should be secured, and efforts will be made by the Governor in Council to prevent changes in future. In personnel, however, the Department has also had two conspicuous gains, in Dr. Mann as Principal of the Agricultural College and in Mr. Keatinge, the present Director, who is the first officer, since Mr. E. C. Ozanne, who has brought to the permanent charge of the Department a complete training in scientific agriculture.

2. The Agricultural College continues to make steady progress in spite of the difficulties due to the continuance of plague, which, no doubt, hinders the students from joining, and to the imperfection of the existing temporary accommodation which has to be used pending the completion of the new buildings in the construction of which progress is regrettably slow. Government trust that men will not be deterred from joining the College by the relatively exacting nature of the course. Apart from the inestimable value of a course of study which will lead to the improvement of agriculture, the staple industry of the country, the course has the special general merits of thoroughness and the development of habits of accurate observation and registration of facts. The value which is set upon the course by Government has recently been emphasised by the appointment of a Graduate in Agriculture to the Provincial Service. No endeavours will be spared by Government to secure lucrative employment for men who distinguish themselves in this branch of study.

3. The importance and rapidly extending work of the College are such that, in the opinion of Government, it would be advisable to submit a separate report (which should be prepared by the Principal) of more extended character, such as is submitted for the Veterinary College. There will be no objection, should the Director prefer it, to the publication of the report as an appendix to the Annual Report of the Department.

4. The number of stations and sub-stations is steadily increasing, and there can be no question that the charge of the Deputy Director, Presidency proper, and of the Professor of Agriculture are too large. With the appointment of Divisional Inspectors it may be hoped that the burden on these two officers will be lightened. One of the main objects in providing for an advanced training in agriculture was that in time the Presidency would be able to officer its own Agricultural Department, and it is satisfactory to note the Director's statement that many of the College students will turn out skilled scientific investigators and practical agriculturists.

5. The record of the work performed has suffered owing to the fact that Mr. Knight and Dr. Mann have been prevented by illness from personally

* Not printed.

summarising what they have done. The record, however, is, on the whole, decidedly satisfactory. It shows that in several different directions the researches that had been made are likely to eventuate in practical and profitable results. Two such results have been clearly established and brought into operation. The first of these is the successful distribution of Broach cotton in the Dhárwár District, which, it is now certain, is attended with substantial advantage to the cultivator, and the second is the introduction throughout the Sátára District of various foreign varieties of groundnut, the superiority of which over the indigenous kind, in yield, earlier maturity and price, have been conclusively demonstrated. In recent orders the Governor in Council has emphasised the great importance attached to *rábi* experiments such as those in the charge of Mr. Knight. Perhaps the Alibág Agricultural Association could be induced to start a duplicate set of experiments. It is observed with satisfaction that private individuals, both merchants and cultivators, have begun to refer to the Agricultural Chemist for information likely to be valuable to them.

6. Mr. Henderson's experiments in the reclamation of "kalar" land give excellent promise of being successful. The washing and draining of 5 acres of bad "kalar" land on the Mirpur Khás farm has given very satisfactory results. The far larger experiment on four hundred acres under the Daulatpur canal has made a good start, and results of inestimable value are approaching attainment. The prospect of establishing the superior economy of the power cane-crusher compared with the ordinary mill worked by bullocks and of sulphate of ammonia as the best of top-dressing for sugarcane are decidedly favourable. In Entomology also it seems likely that a valuable discovery has been made of a practical method of stopping the ravages of the potato-boring insect.

7. In order to make Egyptian cotton a success in Sind, many difficulties, it is clear, have still to be met. There is no reason, however, to regard them as insuperable, and once the Department succeeds in demonstrating that the net profits of Egyptian cotton properly cultivated and under suitable conditions are handsome, there is no reason to fear that the zamindár will fail to take up the crop with enthusiasm. Special orders have been issued with the object of securing an unfailing and sufficient water-supply in time to enable the crop to be sown early in the year.

8. Mr. Main seems to have proved that the difficulties in fixing types of profitable cotton hybrids are greater than his predecessor, Mr. Fletcher, supposed; but enough has been established to show that improvement of varieties can be obtained by judicious hybridisation, and results of such great value have been obtained from this process in America that there can be no doubt that the experiments should be pursued with undiminished vigour.

9. The complete success of the gathering at Sangamner seems to support the Director's view that in these small shows the Department may find a more useful means of communicating results and promoting improved cultivation than the larger exhibitions which, however, together with conferences such as that of Ahmedabad, have undoubtedly their own uses.

10. The Director has clearly shown the success of the experiments made for spreading agricultural knowledge and getting into touch with the public and the cultivating classes. The Governor in Council entirely concurs with the Director's remarks regarding the necessity of obtaining clear ideas and precise facts before going to the cultivators with advice, and also as regards the value, for them among other purposes, of preparing leaflets for distribution. For the dissemination of information, however, leaflets alone will be of little use. The principal thing required is accurate determination of profitable results followed by oral and visual demonstration. For these purposes, there can be no doubt that additional staff is necessary. As soon as the Director can show that he has ready men sufficiently well trained as lecturers and demonstrators, the Governor in Council will make no difficulty in sanctioning, so far as funds permit, the additional establishment required.

11. The Governor in Council has already expressed his views regarding the development of Agricultural Associations. Progress in this direction must of necessity be cautious and gradual. The object should be to establish bodies

endowed with genuine vitality, such as the Associations of Dhárwár and Sangamner, by means of which the Department can spread and gather useful practical information.

12. The Governor in Council is pleased to express his entire approval of the manner in which the Department was administered during the year under report by Messrs. Mead and Keatinge.

J. E. C. JUKES,
Under Secretary to Government.

To

The Commissioner in Sind, The Commissioner, N. D., The Commissioner, C. D., The Commissioner, S. D., All Collectors, including the Collectors and Deputy Commissioners in Sind.	With one copy of the Report, and with an intimation that the requisite number of copies of it will be supplied to them by the Director of Agriculture.
The Director of Agriculture and of Co-operative Credit Societies, The Settlement Commissioner and Director of Land Records, The Conservator of Forests, N. C., The Conservator of Forests, C. C., The Conservator of Forests, S. C., The Deputy Conservator of Forests in charge Sind Circle, The Colonization Officer, Jámráo Canal, The Accountant General, The Director of Public Instruction, The Principal of the Agricultural College, Poona, The Educational Department of the Secretariat, The Political Department of the Secretariat, The Public Works Department of the Secretariat.	With copies of the Report.
The Government of India, The Under Secretary of State for India.	By letter.

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